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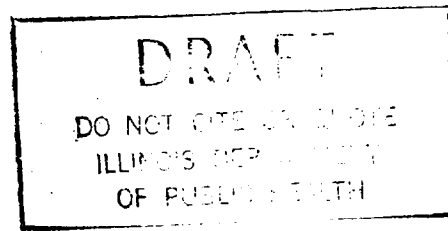
PUBLIC HEALTH ASSESSMENT

AREA 1 - SAUGET SITES

SAUGET, ST. CLAIR COUNTY, ILLINOIS

CERCLIS # - Currently being scored

August 11, 1993



Prepared by

**Illinois Department of Public Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry**

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TABLE OF CONTENTS

SUMMARY	1
BACKGROUND	2
A. Site Description and History	2
Site G	2
Site H	3
Site I	4
Site L	5
Site M	6
Dead Creek Sectors A, B, C, D, E, and F	7
B. Site Visit	11
C. Demographics, Land Use, And Natural Resource Use	11
D. Health Outcome Data	12
COMMUNITY HEALTH CONCERNS	12
ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS	12
A. On-Site Contamination	15
Site G	15
Site H	19
Site I	21
Site L	23
Site M	24
Creek Sectors A-F	25
B. Off-Site Contamination	30
Site G	30
C. Quality Assurance and Quality Control	31
D. Physical and Other Hazards	32
PATHWAYS ANALYSES	32
A. Completed Exposure Pathways	32
Ambient Air	32
Sediment	39
Surface Water	41
Surface Soil	43
Subsurface Soil	44
Ground Water	44
Biota	45

B. Potential Exposure Pathways	45
Ambient Air	45
Sediment	46
Surface Water	46
Surface Soil	46
Subsurface Soil	46
Ground Water	47
Biota	47
PUBLIC HEALTH IMPLICATIONS	48
A. Toxicological Evaluation	48
Polychlorinated Biphenyls	48
Volatile Organic Compounds	49
Semivolatile Organic Compounds	51
Inorganic compounds	55
B. Health Outcome Data	58
C. Community Health Concerns Evaluation	58
CONCLUSIONS	59
RECOMMENDATIONS	60
PREPARERS OF REPORT	61
REFERENCES	63
APPENDICES	66
A. FIGURES	67
B. TABLES	94

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SUMMARY

The Area 1 Sauget Sites consist of Sites G, H, I, L, M and Dead Creek. Sites G, H, and I were borrow pits that were later filled with a variety of wastes including chemicals. Site L was a holding pond for the wash water from cleaning hazardous waste hauling trucks. Site M is a borrow pit that filled with water. Dead Creek stretches from Site I at Creek Sector A (CS-A) and flows south through Sauget and Cahokia before draining into the Prairie DuPont spillway and then into the Mississippi River.

Access to Sites G, I, M, and CS-A and Creek Sector B (CS-B) is restricted. Site H is covered with cinders and Site L has been filled in. Access to Creek Sectors C-F is not restricted. Children have been seen playing in these unrestricted Creek Sectors. Exposure to site related contaminants in the creek sediments pose a public health hazard because of chronic exposure to polychlorinated biphenyls (PCBs) and cadmium, and an increased cancer risk from arsenic, benzo(a)pyrene, and other carcinogenic polycyclic aromatic hydrocarbons. Possible health effects associated with these contaminants may include liver, kidney, stomach, and thyroid gland effects, anemia, and reproductive system damage.

Additional exposures would occur by airborne releases of surface contaminants (primarily from Site G). The population that would be exposed to airborne contaminants from Site G would be nearby residents and employees in nearby businesses and industry. A future source of airborne contaminant exposure would be during remediation of the sites, since Sites G, H, I, and L are known to have subsurface contamination.

Private wells near CS-B are slightly contaminated. An increased cancer risk is possible from the arsenic in ground water. Exposure to ground water can be eliminated since all the homes are connected to a municipal water supply, which has an uptake located in the Mississippi River, upstream of Sauget.

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BACKGROUND

Area 1 is part of the Sauget Sites. Area 1 in this assessment is defined as Sites - G, H, I, L, M, Creek Sectors A through F (CS: A-F). The Sauget Sites as a group are on the State Remedial Action Priority List (SRAPL). The Illinois Environmental Protection Agency (IEPA) is currently having Area 1 scored as an National Priorities List (NPL) site. NPL sites, also called Superfund sites, are sites that have the most serious uncontrolled hazardous wastes or are abandoned sites. The list is designed to identify those hazardous waste sites and provide cleanup money through Superfund. Figure 1 is the area location map for the Sauget Sites. They are in Sauget and Cahokia, Illinois in St. Clair County (Figure 1). Figure 2 is an area location map. The Area 1 sites are in the same general area, and except for CS: D-F have similar wastes.

A. Site Description and History

Site G

Site G was a subsurface surface disposal area which covered approximately 4.5 acres. Site G can be seen on the Figure 3 site features map. It is in Sauget and bordered by Queeny Avenue to the north, Dead Creek to the east, a cultivated field to the south, and Wiese Engineering on the west.

Debris covers most of the site. Site features include two small pits in the northeast and east central portion of the site, the western portion of the site contains a mounded area and large depression just south of the mound which collects much of the sites runoff water. The site has oily and tar-like wastes on the surface in some areas. The chain-link fence that surrounds Site G was constructed in May 1987, in response to high organic contamination in surface soils.

1950	Aerial photographs indicate an excavation. Disposal began sometime after 1950.
Early 1970s	Disposal activities continue. The owners and operators during the waste disposal period have not been identified.
1980-1981	In the IEPA study, Site G was part of an area wide study. This area wide study is summarized in the St. John Report (1981). Sampling during the study included subsurface soil and ground water.

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- 1985 A geophysical investigation was completed in December. Data from this investigation came from flux-gate magnetometry and electromagnetic induction (EM) surveys performed by Techos, Inc., of Miami, Florida.
- 1986 Soil gas surveys were conducted at 12 locations on Site G. In November, 39 surface soil samples were taken by Ecology and Environment (E & E), a contractor. Well drilling and surface soil samples were performed by December 1986, and March 1987.
- 1987 Nine subsurface soil sampling locations were sampled, five monitoring wells were installed adjacent to Site G. In July, six air samples were taken from three on-site locations on two different days.

Site H

Site H was a subsurface disposal area which covers approximately five acres. The site is in Sauget just south and west of the intersection of Queeny Avenue and Falling Springs Road. Site H can be seen in Figure 2, which is the area location map. The site presently appears level and vegetated. Drainage is toward Dead Creek which is west of the site. Access to this site is not restricted.

- Circa 1940 A review of aerial photographs indicates Site H was used for waste disposal.
- 1957 Waste disposal continues until this time.
- 1981 Monsanto Chemical Company submitted a "Notification of Hazardous Waste Form" to the United States Environmental Protection Agency (USEPA). The notification was for Sites H and I, which at one time was a contiguous borrow pit. The dates of operation on the notification were unknown to 1957. The properties were divided by the construction of Queeny Avenue.
- 1980-1981 A monitoring well (G110) was sampled as part of the IEPA hydrogeologic investigation.
- 1985 In December, flux-gate magnetometry and EM was performed on Site H.

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October-November 1986

Twelve soil gas samples were taken at Site H.

December 1986-March 1987

Five subsurface soil borings are taken and three monitoring wells are installed during this time period. The first round of monitoring well sampling took place in March 1987.

1988 Site owned by James Tolbird of Roger's Cartage Company.

Site I

Site I covers approximately the eastern 1/3 of Cerro Copper Products property (Figure 3). The site is just north and east of the intersection of Queeny Avenue and Falling Springs Road in Sauget. Site I covers approximately 55 acres and was the site of a sand and gravel borrow pit. The pit was filled and then covered and graded. Access to the site is restricted by a chain-link fence and a guard at the main gate. Site I runs along the eastern border of CS-A.

A brief history of the site follows.

- | | |
|-----------|---|
| 1937 | Historical photographs indicate that activities at the site began prior to this. |
| 1957 | Cerro DePasco Corporation of New York purchased the existing property, west of Dead Creek Sector A, from Lewin-Mathes Corporation. |
| 1955-1962 | Examination of aerial photographs taken during this period indicate subsurface disposal was discontinued during this time period. The photographs also show Sites H and I as being a contiguous subsurface disposal area. |
| 1981 | Monsanto Chemical Company submitted a "Notification of Hazardous Waste Site Form" to USEPA. The notification indicated that organic and inorganic compounds, and solvents were disposed of in drums. They listed the years of operation from unknown to 1957. |

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1985 IEPA's hydrogeologic survey included installing one monitoring well downgradient from Site I. Site access was denied during the geophysical stage of the hydrogeologic survey, so it was not mapped for magnetic anomalies.

October-November, 1985

Sixteen soil gas samples taken at Site I.

December 1986-March 1987

Subsurface drilling and sampling and some monitoring wells were developed during this period. Five soil borings and five monitoring wells were developed on Site I.

March 1987 The first round of monitoring wells are sampled at Site I.

Site L

Site L is a former surface impoundment that was used to dispose rinse water from truck cleaning operations of a hazardous waste hauler (Figure 3). The impoundment was approximately 70 feet by 150 feet and was 500 feet south of Queeny Avenue and approximately 125 feet east of Dead Creek in Cahokia. The site is level, covered with black cinders, and is being used to store heavy equipment. Access to the site is not controlled.

The Waggoner Company, owned and operated by Harold Waggoner, specialized in transporting hazardous waste. The site history is given below.

1964-1974 Harold Waggoner owned and operated a hazardous waste trucking company.

Prior to 1971 Waggoner reportedly discharged rinse water from his trucks to Dead Creek.

April 1971 IEPA inspector observed a Waggoner Company tank truck discharging materials directly to Dead Creek.

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July 1971	IEPA ordered Mr. Waggoner to stop discharging waste to Dead Creek.
August 1971	Afterwards Waggoner excavated a pit on-site, which was used for storage of waste waters.
1974	Waggoner sold the business to Ruan Trucking.
1974-1978	Site owned by Ruan Trucking. The storage pit reportedly used by Ruan Trucking for the same purpose of waste water storage.
After 1978	The property was leased and eventually sold to Tony Lechner of Metro Construction Company.
1971-1978	IEPA estimates that 164,000 gallons of waste water were disposed of into the storage pit.
1980	IEPA took ground water samples from well G109 located approximately 100 feet west of the site. Surface soil samples were collected in the vicinity of Site L.
December 1985	As part of the geophysical surveys done for the Dead Creek Project, Site L was surveyed. The survey included a 200 feet by 200 feet area grid in the disposal area.
December 1986-March 1987	Drilling of three subsurface soil borings and installation of one monitoring well at Site L. Ground water samples were taken in March 1987.

Site M

Site M is a pit just east of Dead Creek Sector-B, approximately 300 feet north of Judith Lane (Figure 4). Site M is a borrow pit that is owned and was used by H. H. Hall Construction. Its dimensions are estimated to be 275 by 350 by 40 feet deep. It is filled with water and connected to CS-B by a drainage-way. The drainage-way is approximately eight feet wide and allows flow between Sites M and CS-B. Site M has no visible signs of chemical dumping. It is surrounded by the same chain-link fence which encompasses CS-B.

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A brief history of the site activities are listed below. No information concerning waste disposal was found.

Late 1940s H. H. Hall Construction Company began excavating a sand pit, which is Site M.

1980 A snow fence is constructed around the pit, as well as, Site CS-B. IEPA and the Cahokia Health Department received numerous complaints from area residents regarding seepage of odoriferous water into basements and well water problems. These complaints involved Sites M and CS-B. IEPA collected sediment and water samples from Site M.

November 1986 Three sediment samples were taken from three locations at Site M. E & E also took 2 surface water samples from two locations at Site M.

October and November 1986

Six soil gas samples were taken from six locations on-site.

Dead Creek Sectors A, B, C, D, E, and F

Dead Creek Sector - A (CS-A) is due west of Site I on Cerro Copper Products property in Sauget. Figure 3 is a site features map of CS-A. The section currently forms two holding ponds which receive and hold surface and roof runoff from Cerro Copper. No wastes are currently being discharged into CS-A, although the waste is discolored and oily presumably from past discharges. The CS-A no longer discharges to the lower sections of the creek due to the blocking of a culvert under Queeny Avenue in the 1970s. Cerro Copper has remediated CS-A.

Creek Sector - B (CS-B) is just south of CS-A between Queeny Avenue and Judith Lane. Figure 3 is a site features map of CS-B. Part of CS-B is in Sauget and part is in Cahokia. The culverts at both Queeny Avenue and Judith Lane have been blocked to prevent the contamination in the creek from flowing into the lower portion of the creek. CS-B is encompassed by a chain-link fence which was installed by the USEPA in 1982. The banks of the creek are heavily vegetated and the northern half contains debris on the surface.

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Prior to 1970	Creek Sector-A reportedly received discharges from Monsanto and other companies.
Early 1970s	Monsanto and Cerro Copper Products sealed the culvert under Queeny Avenue to restrict the flow of the holding ponds. This stopped flow between CS-A and CS-B.
March 1971	The Cahokia Health Department received complaints from area residents regarding chemical discharges to Dead Creek.
April 1971	An Illinois Department of Public Health (IDPH) inspection of CS-B indicated that there was no discharge from CS-A following the sealing of the Queeny Avenue culvert.
May 1975	IEPA visited the CS-A and CS-B area to determine if discharges to the Creek were occurring. They observed discoloration in the Creek and along the banks. This discoloration was similar to that of the holding ponds on Cerro Copper (CS-A).
July 1979	Complaints received by IEPA concerning fires and smoldering in CS-B.
1980	An IEPA investigation of the Dead Creek Project included CS-A and CS-B. The holding ponds in CS-A are identified as a major source of contamination in the area. Included in the sampling were 20 surface sediment samples from CS-B.
May 1980	The IEPA received additional complaints concerning fires in Dead Creek.
August 1980	An incident occurred in which a local resident's dog allegedly died from chemical burns resulting from exposure to chemicals in the Creek bed.
September 1980	IEPA water and sediment samples from CS-B reveal high levels of a variety of organic and inorganic compounds.

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September 1980	The IEPA sealed Site CS-B and the Illinois Department of Transportation (IDOT) completed construction of a snow fence with warning signs surrounding Site CS-B.
October 1980	IEPA initiated a hydrogeologic investigation in the Dead Creek area to determine the source(s) of contamination in the Creek.
November 1980	IEPA sampled water and sediments in CS-A. The results indicated high concentrations of PCBs and hydrocarbons.
December 1980	USEPA and Technical Assistance Team (TAT) contractor inspected Site CS-B for possible immediate removal action. The result of the inspection indicated that immediate removal was not necessary.
March 1982	<p>USEPA collected private well and garden soil samples from residents in the Dead Creek area. The results showed little contamination. Sediment samples taken from CS-A and a monitoring well on Cerro property.</p> <p>USEPA Field Investigation Team (FIT) contractor conducting air monitoring on Site CS-B. Organic vapors were found at levels up to 900 parts per million (ppm).</p>
October 1982	USEPA completed the construction of a chain-link fence, which surrounds Sites CS-B and M. The chain-link fence replaced the snow fence put up by IDOT.
October 1983	IEPA conducted an investigation at Site CS-B in order to determine the scope of the proposed cleanup at the sites.
December 1984	<p>IEPA submitted the Hazard Rank System (HRS) score for Dead Creek and surrounding sites. The score of 29.25 was not accepted by USEPA due to a lack of documentation at the Sites.</p> <p>IEPA selected a contractor for a limited scope cleanup of CS-B. The IEPA later reconsidered and delayed any cleanup activity until a detailed investigation of the area was completed.</p>

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June 1985 Area residents sent a petition to the Governor's Office requesting the cleanup of Dead Creek. "Clean Illinois" money appropriated for Remedial Investigation/Feasibility Study (RI/FS).

October-November 1986

A soil gas survey was conducted by E & E. Three samples were taken from CS-A and six in CS-B. Also sediment and surface sediment samples taken from these areas.

July 1987 Air samples were taken in the vicinity of CS-B.

1990 The visually contaminated soil in CS-A was removed by Cerro Copper. This operation was overseen and approved by the IEPA.

Figure 2 and 5 shows the Dead Creek Sectors C-F, which is that portion of the creek south of Judith Lane. This portion runs through Cahokia and empties into the Prairie DuPont Floodway. The floodway then discharges to the Mississippi River. The creek is wider in these sections and the banks are not as heavily vegetated as they are in CS-B. In the southern section of CS-D, in the Parks College area, the creek runs underground through corrugated pipe. It re-surfaces briefly at the intersection of Route 157 and Falling Springs Road. The creek then turns west and through a series of culverts drains into a wetland area west of Route 3. The delineations of Sectors C-F can be seen in Figure 9. The access to these sections of the creek are unrestricted and it runs through residential areas.

A brief history of Creek Sectors C-F are given below. No known regulatory actions have taken place in these sectors.

1980 The IEPA collected five sediment and two surface water samples from Creek Sectors C-F as part of the Preliminary Hydrogeologic study. The water samples show very little evidence of contamination.

1986 A soil gas survey of the Dead Creek area included in three samples in CS-C.

November 1986

E & E collected two surface water and four sediment samples from both CS-C and CS-D.

Sauget Sites Area 1 Public Health Assessment - First Draft

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March 1991

Five private water well samples, four soil samples from residential yards, and nine sediment samples were taken from CS-D through CS-F by IEPA.

B. Site Visit

Several site visits have been made to the Area 1 Sites by Department personnel. Site I and CS-A are surrounded by a chain link fence and on Cerro Copper property. Site I is a parking lot for trucks and heavy machinery. The fence line around Site I is under camera surveillance. Access to Site G is restricted by a chain link fence. Odors have been noted during visits along the northern perimeter of Site G. Overgrown vegetation covers Site G, some of which appears to be stressed. The northern portion of CS-B, runs along the eastern boundary of Site G and is also fenced and is covered with overgrown vegetation. Site M can be seen from the dead end on Walnut Street. Access to Site M and CS-B is restricted by a fence along their perimeter. This fence is intact along the eastern perimeter along the dead end on Walnut Street. The south end of CS-B can be seen from Judith Lane. The fence along Judith Lane has a hole underneath that is large enough to allow access to children, pets, and adults. The bottom of this section of CS-B is covered with pieces of shredded tires. CS-C through CS-F are overgrown in many areas with residential yards abutting the site boundaries. CS-C through CS-F have unlimited access. Many odors were noted throughout the Sauget area, which is a highly industrialized area.

C. Demographics, Land Use, And Natural Resource Use

The population (1990 census) within a three mile radius of Site H includes: Sauget - 197, Cahokia - 17,550, Centreville - 9489, East St. Louis - 40,944 and Alorton - 2960. The population within a three-mile radius includes all of Sauget, Cahokia, Centreville, and Alorton and four-fifths of population of East St. Louis. The population within a three-mile radius is estimated to be 60,750. The population within the two-mile radius of Site H is estimated to be 31,447, which includes all of Sauget and Alorton, half of Centreville (1480), three-fourths of Cahokia (13,163), and one-third of East St. Louis (13,647). The population within a one-mile radius is estimated to be 4146, and includes all of Sauget, one-sixth of Cahokia (2925), and one-fortieth of East St. Louis (1024).

Land use in the area is primarily industrial, with over 50 percent of the land being used for this purpose. Figure 6 is a land use map of the Sauget/Cahokia area. Residential, commercial, and agricultural areas are interspersed throughout Sauget. Land use in Cahokia consists of residential, commercial, and agriculture areas. Land use in and around the Area 1 sites are industrial, residential, and commercial. Hunting for upland game may occur in

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vacant areas east of the site possibly along the railroad tracks. Recreation on the Mississippi River includes fishing, both commercial and sports, waterfowl hunting, swimming, and water skiing.

D. Health Outcome Data

No health outcome data has been compiled for the Sauget area. The State of Illinois maintains several data bases containing health information. The Illinois Health and Hazardous Substances Registry is an Act whose primary purpose is to monitor health effects related to work place and environmental exposures to hazardous substances. The Registry contains information on the incidence of cancer, adverse pregnancy outcomes, and occupational diseases. Information in the cancer registry is for the years 1985 through 1991. The cancer registry data can be broken down by either county or zip code. The adverse pregnancy outcomes reporting system (APORS) data can be used to identify and analyze environmental influences on pregnancy outcomes and identify high risk populations or geographical areas in Illinois.

COMMUNITY HEALTH CONCERNS

Concerns have arisen since a resident's dog fell into Dead Creek and allegedly died from chemical burns. It was this incident that led to an investigation of the Dead Creek area by IEPA personnel. The IEPA has conducted extensive work in this area and they have not identified any public health concerns. No other community health concerns have been identified by this Department.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

The tables in this section list the contaminants of concern in the different media. The contaminants of concern that are listed in this section will later be evaluated to determine if they represent an exposure of public health significance. **The listing of a contaminant in the following tables does not necessarily mean that the contaminant poses a threat to public health.** These chemicals were chosen based on the following criteria:

- 1) Concentrations on and off the site.
- 2) Field quality data, laboratory quality data, and sample design.

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- 3) **Comparison of on-site and off-site concentrations with background concentrations, if available.**
- 4) **Comparison of on-site and off-site concentrations with health assessment comparison values for (1) non-carcinogenic end points and (2) carcinogenic endpoints.**
- 5) **Community health concerns.**

The tables in this section contain the following acronyms:

CREG = Cancer Risk Evaluation Guide

EMEG = Environmental Media Evaluation Guide

EPA = United States Environmental Protection Agency

IDPH = Illinois Department of Public Health

IEMEG = Intermediate Environmental Media Evaluation Guide

IEPA = Illinois Environmental Protection Agency

LTHA = Lifetime Drinking Water Health Advisory

MCL = Maximum Contaminant Level

ND = Not Detected

NL = Not Listed in ATSDR comparison values

PMCL = Proposed Maximum Contaminant Level Goal

ppm = parts per million

RfD = Reference Dose

RMEG = Reference Dose Media Evaluation Guide

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ICRC = Inhalation Cancer Risk Concentration

Environmental Media Evaluation Guides (EMEGs) are media-specific comparison values that are used to select contaminants of concern at hazardous waste sites. These chemicals are chosen based on toxicity, frequency that they occur at NPL sites, and the potential for human exposure. EMEGs are derived from Minimal Risk Levels (MRLs) which are developed by ATSDR and are an estimate of human exposure to a compound that is not expected to cause noncancerous health effects at that level for a specified period of time. They are supposed to protect the most sensitive individuals (e.g. children). MRLs are not cutoff levels and are not predictors of adverse health effects. MRLs do not take into account carcinogenic effects, chemical interactions, multiple routes of exposure, or multi-media exposures.

A Reference Dose (RfD) is an estimate of a daily exposure to a human population (including sensitive individuals) that is not expected to increase the risk of noncancerous adverse health effects in that population over a lifetime. They were developed for chemicals found at NPL sites.

Reference Dose Media Evaluation Guide (RMEGs) are comparison values that were developed to select contaminants of concern. They are chosen based on toxicity, frequency of detection at NPL sites, and potential for human exposure. They are derived from Reference Doses (RfD) which are developed by USEPA. They are not predictors of adverse health effects and do not take into account carcinogenic effects, chemical interactions, multiple routes of exposure, or multi-media exposures.

Cancer Risk Evaluation Guides (CREGs) are based on a contaminant concentration that is estimated to increase the cancer risk in a population by one individual in one million people over a lifetime of exposure. These values are calculated to protect sensitive members of the population.

Maximum Contaminant Levels (MCLs) have been established by USEPA for public water supplies to reduce the chances of adverse health effects from contaminated drinking water. These standards are well below levels for which health effects have been observed and take into account the financial feasibility of achieving specific contaminant levels. These are enforceable limits that public water supplies must meet. These values are only considered if no EMEG, CREG, RfD, RMEG, or LITHA are available for the chemical. Proposed Maximum Contaminant Levels (PMCLs) are sometimes used in the absence of MCLs. These are proposed standards under consideration by the USEPA, but are not legally enforceable.

with Advisories (LTHAs) are contaminant concentrations in water likely to cause noncarcinogenic adverse health effects at that level.

Compounds released in the vicinity of the site by other industries were determined among other information. This data was examined for the amounts and types of water, air, and water, and released to the environment. The TRI data are from industries in East St. Louis. All the reported releases from area industries were into the air. Table 1 reported to be released into the soils' surface, surface water, or ground water. Table 1 released the compound.

A. On-Site Contamination

Site G

The investigation of on-site contamination at Site G began in 1980. The first study was performed by the IEPA and the results were reported in the Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vicinity in 1980-81 also known as the St. John Report (1981). The location of samples collected in the vicinity of Site G are shown in Figure 7.

Subsurface and ground water samples were collected from Site G with surface water and sediment samples collected from nearby sections of Dead Creek (CS-B). Monitoring well G107 is a surface depression approximately 50 feet south of the site. Wells G101 and 104 were installed south of the site as part of the general area investigation. Well 106 had concentrations of polychlorinated biphenyls (PCBs) and metal concentrations above the IEPA water quality standards, the metals included arsenic, barium, copper, lead, and manganese. A subsurface sample taken by IEPA in 1980 while boring well G106 contained trace levels of PCBs at depths between 7.5 and 13 feet. In October 1984, IEPA collected three soil samples from a pit in the northeast corner of Site G. High levels of metals were found in only one of three samples. Other surface samples taken adjacent to Site G are included in Creek Sectors CS-B.

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Geophysical Investigation

A geophysical investigation of Site G was completed in December 1985, and included flux-gate magnetometry and electromagnetic induction surveys. The magnetometer survey at Site G showed that a major magnetic anomaly covers most of the northern portion of the site. Several smaller anomalies were found north of the large depression in the southwest corner of the site. The mounds in the northwest corner of the site showed smaller anomalies at the surface and larger anomalies for deeper readings, indicating significant quantities of buried metals.

An EM survey of Site G indicated three areas of anomalies including a 50 by 20 foot area in the northeast corner, a 150 feet by 120 feet area in the east-central portion, and in the entire mounded area along the western perimeter of the site. The EM readings in the northwest corner showed anomalies going off-site which may indicate that the fill area extends under Queeny Avenue. The magnetometry map of Site G is Figure 8.

Soil Gas Survey

A soil gas survey of Site G was performed between October and November 1986. Survey locations for Site G are shown in Figure 9. Figure 10 is a map of the soil gas analyses results for Site G. The soil gas readings give an indication of the volatile organic compounds in the surface soil gas. The results for the site are limited; the highest results are sample SG-12, at greater than 100 microgram per liter ($\mu\text{g/L}$).

Surface Soil Sampling

E & E took forty-three surface samples at Site G in November 1986. Generally the surface samples detected volatile organic compounds, semivolatile organic compounds, pesticides, PCBs, and inorganic compounds. A summary of the organic compounds found in surface soils at Site G are given in Table 2. Figure 11 gives total organic concentration in surficial soils. Compounds that were found in the blanks are not included in this table.

The most frequently identified compound was 4-methyl-2-pentanone, being detected in 22 of the 43 samples. It was also found in the highest concentrations of any organic compound. The greatest number of volatile organic compounds, seven, was found in sample SS-38.

Thirty-three of the 43 surface soil samples in Site G contained semivolatile organic compounds. Twenty-six different kinds of semivolatile organic compounds were identified. Compounds that were found at the highest concentrations were

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1,4-dichlorobenzene at 22,000 micrograms per kilogram ($\mu\text{g/kg}$) and pentachlorophenol at 21,000 $\mu\text{g/kg}$. Pentachlorophenol was detected in 14 samples and it was the most frequently detected semivolatile organic compound. The pentachlorophenol concentrations at Site G have been mapped and are shown in Figure 12. Benzo(a)Pyrene was detected at low levels (the highest sample was estimated at a value of 22 $\mu\text{g/kg}$, which was below the detection limit) in 13 samples.

PCBs were detected in 40 of 43 samples taken from Site G. Three congeners of PCB were detected: Aroclor-1248, Aroclor-1254, and Aroclor-1260. The highest PCB concentrations were in samples SS-11 where Aroclor-1248, Aroclor-1254, and Aroclor-1260 were found at 24,000 $\mu\text{g/kg}$, 29,000 $\mu\text{g/kg}$, and 21,000 $\mu\text{g/kg}$, respectively. Six samples from Site G contained PCB concentrations at levels greater than 1000 $\mu\text{g/kg}$. The distribution of PCB concentrations in surficial soils at Site G is shown in Figure 13. The pesticide degradation product 4,4'-DDE was detected in 5 of 43 samples. The highest 4,4'-DDE was 0.3 $\mu\text{g/kg}$.

Two composite surface soil samples consisting of one sample from grid sections B3 through F3 and the other from grid sections A7, A8, and B6 through B8 (see Figure 14) were analyzed for 2,3,7,8-TCDD. TCDD was not detected in either sample. Only one dioxin compound, Octachlorodibenzo (b,e)-1,4-dioxin (OCDD), was detected in 3 of 43 samples. This dioxin's highest concentration was 130 $\mu\text{g/kg}$ in samples SS-25. The grids which contained the OCDD were not included in the composite samples which were analyzed for 2,3,7,8-TCDD.

Inorganic compound analyses of the 43 samples revealed elevated levels of antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, vanadium, and zinc. These levels were elevated when compared to the background samples.

Subsurface Soil Sampling

Ten subsurface soil samples at eight locations were taken at Site G. The location and total organic concentrations are shown in Figure 15 and a summary of subsurface soil samples analyses are given in Table 3. Ten samples were taken on-site and volatile organic compounds were detected in nine of these samples.

Semivolatile organic compounds were found in seven of ten subsurface samples. The highest concentrations of semivolatile organic compounds in subsurface Site G samples were naphthalene and pentachlorophenol at 5,400 $\mu\text{g/kg}$ and 4,800 $\mu\text{g/kg}$, respectively.

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Two PCB congeners, Aroclor-1260 and Aroclor-1248, were detected in six and one samples, respectively. The highest concentration of Aroclor-1260 was 4,400 $\mu\text{g/kg}$, while the concentration of Aroclor-1248 was 174 $\mu\text{g/kg}$ in sample number G9-71.

When compared with background samples, several inorganic compounds were found at elevated concentrations. The inorganic compounds found at elevated concentrations include arsenic, barium, chromium, cobalt, copper, lead, mercury, nickel and vanadium. The highest levels of organic compounds exceeded the background samples by approximately 100 times.

Ground Water

In 1987, one round of ground water sampling was taken from four on-site wells. Figure 16 gives the location of each well and Figure 17 gives the total organic concentrations found. Well EEG-107 was sampled twice with GW20 being a duplicate sample of GW19. A summary of the ground water analyses is given in Table 4.

The number of volatile organic compounds found in samples GW19 and GW20 were eleven and nine, respectively. The highest concentrations of compounds in GW19 were benzene, toluene, and chlorobenzene at 4100 $\mu\text{g/l}$, 7300 $\mu\text{g/l}$, and 3100 $\mu\text{g/l}$, respectively. These same three compounds (benzene, toluene, and chlorobenzene) were found in GW20 at concentrations of 3700 $\mu\text{g/l}$, 6300 $\mu\text{g/l}$, and 3100 $\mu\text{g/l}$, respectively. Volatile organic compounds in the other three wells included benzene in wells GW32 (460 $\mu\text{g/l}$) and GW33 (1800 $\mu\text{g/l}$) and chlorobenzene in well GW32 (2500 $\mu\text{g/l}$). The only volatile organic compounds detected in GW34 was chlorobenzene at a concentration of 20 $\mu\text{g/l}$.

Semivolatile organic compound analyses results from GW19 and duplicate GW20 detected 13 contaminants common to both including high concentrations of benzene (35,000 and 150,000 $\mu\text{g/l}$), phenol (6,600 and 30,000 $\mu\text{g/l}$), and naphthalene (21,000 and 18,000 $\mu\text{g/l}$). In addition to the 13 compounds common to both wells, GW20 contained 2,4,6-Trichlorophenol at a concentration of 350 $\mu\text{g/l}$.

No semivolatile organic compounds were found in sample GW34. Sample GW32 contained six semivolatile organic compounds including 2-chlorophenol, 2,4-Dimethylphenol, and 4-chloroaniline at concentrations of 130, 240, and 15000 $\mu\text{g/l}$, respectively. Sample GW33 contained nine semivolatile organic compounds including 1,4-Dichloroaniline.

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Aroclor-1260 was the only PCB congener found in on-site ground water. Only well EE-G107 samples GW19 and GW20 had this PCB congener. The concentration of Aroclor-1260 in GW19 and GW20 was 890 $\mu\text{g/l}$ and 650 $\mu\text{g/l}$, respectively.

The monitoring wells in and around Site G contained elevated amounts (above background levels) of the following inorganic compounds: antimony, arsenic, cadmium, chromium, cobalt, mercury, nickel, vanadium, and zinc.

Air Sampling

Air sampling was conducted at three locations at Site G on two separate days. Figure 18 shows the locations of the air monitors. Figure 19 gives the sample results of selected organic compounds for July 16, 1987, and Figure 20 gives the results for July 17, 1987. Results of the on-site air sampling are contained in Table 5 under samples DC-01, DC-04, DC-06, DC-10, DC-11, and DC-13.

The only volatile organic compound detected on-site was benzene, however, it was also detected in the blank samples. The semivolatile organic compounds found in Site G air samples were naphthalene, phenanthrene, 2-nitroaniline, and fluorene.

PCB congeners detected on-site were Aroclor-1248, Aroclor-1254, and Aroclor-1260 with their highest concentrations being 0.3 microgram per cubic meter ($\mu\text{g}/\text{m}^3$), 0.18 $\mu\text{g}/\text{m}^3$, and 0.17 $\mu\text{g}/\text{m}^3$, respectively.

Site H

The investigation of on-site contamination at Site H began in 1980. The first study was performed by IEPA and the results were reported in the Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vicinity, April 1981, also known as the St. John Report. As part of the Dead Creek Project, a geophysical survey was performed.

Geophysical Survey

The geophysical survey included flux-gate magnetometry and EM and was conducted in December, 1985. A survey grid with the dimensions of 520 feet by 550 feet was laid out over the site. The results of the magnetometer survey indicated three large areas of major magnetic anomalies and two smaller areas (see Figure 21). The anomalies are of a great enough magnitude to indicate buried drums or other ferrous materials. The southern most

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anomaly correlates well with a depression in a previous aerial photograph. The other two large anomalies correlate somewhat with other depressions in the aerial photographs.

An EM evaluation of the site was performed using a variety of coil spacings for different depths. The results of the shallow (0 to 7.5 meter) depth indicated three high intensity anomalies, which correlated well with the magnetometer anomalies. There were also three negative anomalies in the north and central portions of the site, which represent areas of low conductivity and possibly the location of organic compounds.

Soil Gas Survey

In October and November 1986, soil gas samples were collected in Area 1 including Site H. Twelve on-site locations were tested for volatile organic gases in the subsoil of Site H. Figure 9 gives the locations and Figure 10 the concentrations of the soil gas samples. Six of the locations had volatile organic soil gases at concentrations greater than 1000 milligrams per liter (mg/l).

Subsurface Soil Sampling

Ten subsurface samples were analyzed from eight locations on Site H. The total organic concentrations of these samples and their locations are given in Figure 15. A total of 10 volatile organic compounds were found in 10 samples at Site H. One sample contained seven different volatile organic compounds, two samples contained six different volatile organic compounds, and one sample contained five different volatile organic compounds. Chlorobenzene had the highest concentration at 450 mg/kg. Three samples did not contain any volatile organic compounds.

Semivolatile organic compound analyses of 10 subsurface soil samples from eight boring locations reveal a total of 32 different semivolatile organic compounds in nine samples. One sample contained 32 semivolatile organic compounds. The highest concentrations were 30,000 mg/kg of 1,4 dichlorobenzene; 19,000 mg/kg of 1,2-dichlorobenzene; and 7,600 mg/kg of 1,2,4-trichlorobenzene.

Ten subsurface soil samples from Site H contained three pesticides and one PCB congener. The pesticides, 4,4-DDE and 4,4-DDT were detected in two samples; and 4,4-DDD was detected in one sample. Aroclor-1260 was detected in six of 10 samples with the highest concentration being 18,000 mg/kg.

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Ground Water

Three wells were installed by E & E on Site H. The location of these wells and the total organic concentrations found in these wells is given in Figure 17. The wells on Site H were sampled on March 17, 1987.

Volatile organic compounds were detected in all wells at Site H. Seven different volatile organic compounds were detected including benzene, toluene, and chlorobenzene. The highest concentrations of these three compounds are benzene at 4.3 mg/l, toluene at 7.3 mg/l, and chlorobenzene at 11 mg/l. Benzene and chlorobenzene were found in all three ground water samples.

Twenty four semivolatile organic compounds were detected in the three ground water samples taken from Site H. The highest semivolatile organic compound concentration was 4-chloroaniline at 6.4 mg/l. 4-chloroaniline was also detected in all three wells.

No pesticides were detected in the March 17, 1987, ground water sampling at Site H. Aroclor-1260 was the only PCB congener detected at Site H. Aroclor-1260 was detected in Well EE-01 at a concentration of 0.053 mg/l.

Site I

A preliminary investigation of the hydrogeology of the Dead Creek area included on-site sampling at Site I. No on-site samples were taken from ground water or soils. An on-site geophysical study was scheduled to be conducted, however Cerro Copper Products, owner of the property, would not allow site access.

Soil Gas Survey

In October and November, 1982, a soil gas survey was conducted in Area 1. Nineteen soil gas samples were taken from Site I and adjacent Site CS-A. Eleven of the 19 samples are in Site I. Figure 10 gives the location and concentrations of samples taken at Site I. Three of the 11 samples had volatile organic soil gas concentrations above 1000 mg/l. These three samples were taken just north of Queeny Avenue.

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Subsurface Soil Investigation

Ten subsurface soil samples were taken from seven locations on Site I. The samples were analyzed for volatile and semivolatile organic compounds, pesticides/PCBs, and inorganic compounds. Table 15 gives the locations and total organic compound concentrations. Volatile organic compounds were found in all 10 samples. Nine volatile compounds which were identified in subsurface soils at Site I are trichloroethene, benzene, toluene, ethylbenzene, xylene, tetrachloroethane, 1,1,1-trichloromethane, 4-methyl-2-pentanone, and chlorobenzene. The highest concentrations (and number of samples in which it was detected) for a selected group of volatile organic compounds are as follows: benzene, 24 mg/kg (9); toluene, 78 mg/kg, (10); ethylbenzene, 15 mg/kg, (9), total xylenes, 19 mg/kg, (9); and chlorobenzene, 127 mg/kg, (10).

Semivolatile organic compounds were detected in all 10 samples. A total of 23 different semivolatile organic compounds were found in the subsurface soil samples from Site I. The following list are those semivolatile organic compounds with at least one sample over 100 ppm. Included with this information are the highest concentrations found and the number of samples in which the compound was detected in parenthesis. These compounds are: 1,4-dichlorobenzene, 1837 mg/kg, (7); 1,2-dichlorobenzene, 324 mg/kg, (6); 1,2,4-trichlorobenzene, 8255 mg/kg, (7); naphthalene, 514 mg/kg, (7); methylnaphthalene, 169 mg/kg, (6); n-nitrosodiphenylamine, 100 mg/kg, (2); hexachlorobenzene, 1270 mg/kg, (7); phenanthrene, 101 mg/kg, (4); anthracene, 203 mg/kg, (2); fluoranthene, 203 mg/kg, (3); and pentachlorophenol, 191 mg/kg, (1).

One pesticide and one PCB congener Aroclor-1260, were identified in the 10 subsurface samples taken from Site I. The pesticide Toxaphene was detected on one sample at a concentration of 493 mg/kg. Aroclor-1260 was detected in five subsurface samples with the highest concentration being 270 mg/kg.

Ground Water

Ground water samples were taken March 23, 1987, samples from four monitoring wells in Site I. The location of these monitoring wells and their total organic concentrations detected from the March 23, 1987, are shown in Figure 17. Two samples were taken from Well EE-12 in the southern portion of the site. Eleven volatile organic compounds were found in four samples. Well EE-13 did not contain volatile organic compounds. Benzene was identified in four of five samples with its highest concentration being 1400 µg/l. Chlorobenzene was detected in four samples with its highest concentration being 3100 µg/l.

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Volatile organic compound contamination in ground water appears in the central and southern portions of Site I.

Nineteen semivolatile organic compounds were found in four ground water samples. No volatile organic compounds were detected in Well EE-13, in the east-central portion of the site. Compounds having concentrations of 1 mg/l or more in a ground water sample are as follows: pentachlorophenol, 2.4 mg/l; bis-(2-chloroethoxy) methane, 2.9 mg/l; 2,4-dichlorophenol, 1.0 mg/kg; 1,2,4- trichlorobenzene, 2.7 mg/kg; and 4-chloroaniline, 8.3 mg/kg.

No PCBs or pesticides were found in ground water samples taken from Site I.

Site L

No on-site samples were taken from Site L during the 1980-81 IEPA investigation. Monitoring well G109 is about 100 feet southwest of Site L. Figure 22 gives the location of the nearest soil samples and monitoring well from the IEPA investigation.

Geophysical Survey

Geophysical surveys were completed on Site L as part of the 1985 Dead Creek Project. These surveys included flux-gate magnetometry and EM. A 200 feet by 200 feet grid was placed across the site. Results of the magnetometer survey indicated a magnetic anomaly in the southwest corner of the site. Another large anomaly could not be accurately assessed. The EM survey indicated a single anomaly of approximately 150 feet by 100 feet in the southwest corner.

Soil Gas Survey

In October and November, 1986, soil gas samples were taken from Area 1. Ten samples were taken at Site L and are given in Figure 10. The highest soil gas reading on Site L was located across the northern one-half of the site. The levels of volatile organic vapors in the five northern samples were three at level > 1000 mg/l, 340 mg/l, and 30 mg/l.

Subsurface Soil

In December 1986, E & E took four subsurface soil samples at three locations at Site L. Figure 15 gives the locations and total organic concentrations. Six volatile organic compounds were found in the four samples. They are: chloroform, benzene,

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4-methyl-2-pentanone, toluene, ethylbenzene, and xylene. Toluene had the highest concentration of any samples (27 mg/kg). One sample had five different volatile organic compounds, while the other three contained four.

Analyses of four samples from three different locations on Site L were performed and revealed 13 different semivolatile organic compounds in three samples. One subsurface sample contained nine semivolatile organic compounds and another contained eight. The semivolatile organic compounds identified in the subsurface soil samples included phenol, 2-chlorophenol, 1,4-dichlorobenzene, 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthalene, pentachlorophenol, phenanthrene, fluoranthene, pyrene benzo(a)anthracene, and chrysene.

No pesticides or PCBs were detected in any of the subsurface soil samples taken from Site L.

Ground Water

One monitoring well was installed by E and E on Site L. The location and total organic concentration found in Well EEG-109 are given in Figure 17. Four volatile organic compounds including chloroform, toluene, and benzene, were detected in the March 24, 1987, ground water samples at concentrations of 0.73 mg/l, 0.97 mg/l, and 0.15 mg/l, respectively.

Six semivolatile organic compounds were found in the ground water sample from Site L. The four highest concentrations of semivolatile organic compounds were phenol, 2-chlorophenol, 4-methylphenol, and 4-chloroaniline at concentrations of 0.15 mg/l, 0.15 mg/l, 0.075 mg/l, and 0.06 mg/l, respectively. No pesticides/PCBs were detected in Well EEG-109.

Site M

In 1980, the IEPA collected two water and two sediment samples from Site M. The locations of these samples can be seen in Figure 22. The samples were analyzed primarily for inorganic compounds, but a few organic parameters were also chosen for analysis. The water samples did not contain excessive amounts of inorganic compounds. PCBs were found at very low levels. Sediment samples analyses detected a cadmium concentration in one sample of 40 ppm. The nickel concentrations in the samples were 1,600 and 590 ppm. The PCB concentrations found in the 1980 sediment samples were: 1,100 ppm in X123, and 24 ppm in X124.

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Additional sediment and surface water samples were taken by E & E in 1986. The locations of the sediment and surface water samples are shown in Figure 23. The analyses results of the sediment samples from Site M can be found in Table 6. Table 7 includes the surface water sample results.

Soil Gas Survey

A soil gas survey was performed around the perimeter of Site M. The locations and total concentrations of contaminants found in the soil gas samples is shown in Figure 10. Six locations were sampled for volatile organic compounds, however only low levels were detected. Two eastern samples contained 18 and 16 mg/l volatile organic compounds (Figure 10). The soil gas appears to be only slightly contaminated.

The contamination at Site M may be from disposal of hazardous wastes directly to the pond or may be coming in through the ditch which connects Creek Sector B and Site M. The PCBs may have been translocated from CS-B.

Creek Sectors A-F

The investigation of on-site contamination at Creek Sector A began in 1980. This first study, the IEPA Preliminary Hydrogeologic Investigation, was completed in 1981. This investigation determined that the holding ponds in CS-A were a major source of ground water in the area. Surface water and sediment samples were taken from the holding ponds in CS-A. Figure 22 shows the location of the samples. Contaminants found in these samples included PCBs, dichlorobenzene, aliphatic hydrocarbons, arsenic, cadmium, chromium, lead, and mercury. No monitoring wells were placed on Site CS-A, but one was placed downgradient from Sites I and CS-A.

A hydrogeologic study was also conducted at CS-B in 1980. This investigation included 20 surface sediment samples and one subsurface soil sample. The locations of these samples can be seen in Figure 7. The samples contained several organic contaminants including PCBs (up to 10,000 ppm), alkyl benzene, dichlorobenzene, trichlorobenzene, and dichlorophenol. Analysis of the subsurface soil sample at boring location P-1 in the northern section of CS-B indicated most contaminants were found from the surface to the three foot depth, but they were absent after three feet. Only PCBs were found at depths greater than three feet and in fact were found at the deepest sampling depth of seven feet. The samples taken from the southern portions of CS-B identified PCBs and dichlorobenzenes as the only organic contaminants detected.

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In December 1982, the IEPA collected two sediment samples from CS-B as part of an area wide dioxin sampling effort which was managed by USEPA. The samples were collected from the east bank approximately 80 yards south of Queeny Avenue and the other sample was collected from the west bank approximately 50 yards south of Queeny Avenue. The samples were analyzed specifically for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The sample from the east bank contained 0.54 parts per billion (ppb) of 2,3,7,8-TCDD, while the sample from the west bank was below the method detection limit.

Twelve monitoring wells were installed surrounding CS-B (Figure 16). No wells were actually placed in the creek. The results of these samples will be given in the Off-Site Contamination Section as well as on-site for those wells that are located on another Area 1 site.

Preliminary air monitoring was performed in CS-B by IEPA in September and October 1980. Draeger pumps and tubes were used for halogenated hydrocarbons. Air sample pumps with charcoal tubes were also used. The Draeger tubes for hydrocarbons showed positive readings in the northern section of CS-B near the location of the former Waggoner building. All other areas surveyed with Draeger tubes yielded negative results. Air samples taken with charcoal tubes, which were later extracted and analyzed in IEPA's Springfield Laboratory, came from two locations. Two samples were taken at each location to monitor disturbed and undisturbed soil conditions. The first location was 40 yards south of Queeny Avenue. No volatile organic compounds were identified in samples of either the disturbed or undisturbed soils. Samples from the second location, 60 yards north of Judith Lane, indicated the presence of xylene in both the disturbed and undisturbed soil conditions.

In March 1982, a USEPA FIT contractor also performed air sampling in the CS-B area. The instruments used were an organic vapor analyzer (OVA), an Hnu photoionizer, and Draeger colormetric tubes for phosgene gas. They found small but measurable concentrations of organic vapors present in the breathing zone (five feet above the ground's surface). The concentrations increased as they got closer to the creek bed. The OVA showed readings of up to 0.5 ppm above background and Hnu readings of up to 9 ppm above background. Analysis of the effluent from a three inch pipeline adjacent to the Waggoner building, which appeared as a small oily stream, resulted in concentrations up to 350 ppm and Hnu concentrations from 400 ppm to 900 ppm. Phosgene gas was not detected in any of the Draeger tube samples.

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Soil Gas Survey

In October and November 1986, a soil gas survey was conducted in Area 1. Eight samples were taken in and along CS-A. Those samples taken near the center of the bed in the southern section of CS-A had the highest volatile organic vapor concentrations in the soil. Three samples had soil organic vapor levels greater than 1000 mg/l. Figure 10 indicates the locations and concentrations of volatile soil gases in CS-A and CS-B. CS-B had seven locations that were sampled. Two of the seven samples were above background at 280 mg/l and greater than 100 mg/l. These two locations were in the northern 300 feet of CS-B.

Surface Water and Sediment Samples

Surface water sampling took place in Dead Creek in November 1986. Two samples were taken from CS-A and three samples from CS-B. The locations and total organic concentrations are given in Figure 23. Organic contamination was found in both sectors. Low levels of volatile organic compounds were identified in CS-A and CS-B. Volatile organic compounds found in CS-A include chloroform, 1,1,1-trichloroethane, carbon tetrachloride, and trichloroethane. No volatile organic compounds were found in CS-B samples.

Semivolatile organic compounds were identified in CS-A including 4-chloroaniline, phenanthrene, and naphthalates. CS-B contained one semivolatile organic compound: 2-nitroaniline. None of the semivolatile organic compound concentrations were above the method detection limit in the surface water samples.

No pesticides were identified in the surface waters of either CS-A or CS-B. PCBs were identified in all three CS-B surface water samples. The only congener found was Aroclor-1260 at concentrations of 3.6, 34, and 44 $\mu\text{g/l}$.

Surface water samples were also analyzed for inorganic compounds. Among the inorganic compounds found at elevated levels were cadmium, mercury, arsenic, chromium, and lead.

Five sediment samples were also taken from each of the Creek Sectors A and B. Creek Sector A sampling depths ranged from 0 to 2 feet. The locations, depths, and total organic compounds for CS-A and CS-B are given in Figure 4. CS-A sediment samples revealed one volatile organic compound, chlorobenzene, which was not found in the blank water samples. CS-B samples all contained volatile organic compounds including 2-Butanone (MEK) in five samples; benzene, toluene, 4-methyl-2-pentanone, chlorobenzene, 2-hexanone, ethylbenzene, and total xylenes in one sample.

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Semivolatile organic compounds were found in sediments of both Sectors CS-A and CS-B. Some of the semivolatile organic compounds found, (and the number of samples in which it was identified) in CS-A are 1,3-dichlorobenzene(2); 1,4-dichlorobenzene(4); 1,2-dichlorobenzene(2); 1,2,4-trichlorobenzene(3); pentachlorophenol(1); benzo(a)pyrene(2); and chrysene(4). Sector CS-B also contained a variety of semivolatile organic compounds including many of the same ones found in CS-A. The semivolatile organic compounds in CS-B (and the number of samples in which they were identified) include 1,4-dichlorobenzene(2); 1,2-dichlorobenzene(1); 1,2,4-trichlorobenzene(3); naphthalene(4); pentachlorophenol(2); benzo(a)pyrene(5); and chrysene(1).

No pesticides were found in either CS-A or CS-B. PCBs were found in all 10 CS-A and CS-B sediment samples. Three congeners of PCBs were found in the sediment of CS-A. These congeners (and the number of samples in which they were identified) are: Aroclor-1248,(3); Aroclor-1254,(5); and Aroclor-1260,(4). The same three congeners were found in CS-B. These congeners (and the number of samples in which the congeners were identified) are as follows: Aroclor-1248,(1); Aroclor-1254,(2); and Aroclor-1260,(5).

Ground Water Sampling

One ground water monitoring Well EE-15 is located in CS-A. The well was sampled on March 23, 1987. Eight volatile organic compounds were detected in the sample. The three highest volatile organic compound concentrations found in Well EE-15 were trans-1,2-dichloroethene at 0.31 mg/l; and 1,1-dichloroethane and chlorobenzene both with concentrations of 0.12 mg/l. Five semi-volatile organic compounds were detected in the monitoring well in CS-A. The highest concentration of a semivolatile organic compound in Well EE-15 was 4-chloroaniline at 0.018 mg/l. No PCBs or pesticides were found in the monitoring well sample from CS-A. No monitoring wells were located on Site CS-B, however, two wells were located just off-site. Figure 17 gives the location and total organic compound concentrations at the monitoring well on CS-A and the wells surrounding CS-B.

In 1980, as part of the preliminary hydrogeologic investigation, five sediment and two surface water samples were taken from Creek Sectors C-F (CS-C-F). The locations of these samples in the southern portion of Dead Creek are shown in Figure 22. The samples were analyzed for many inorganic compounds and only a few organic compounds. The water samples showed little or no contamination. Sediment samples contained elevated levels of lead, cadmium, and nickel among the other inorganic compounds. Organic contamination consisted of PCBs in four of five sediment samples. Sample X105 had the lowest contaminant levels, but this was expected since it was the furthest downstream sample.

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Cadmium, chromium, lead, and nickel in Sectors C-F were found at higher levels than those of Sector B. PCBs were lower than those found in CS-B.

Soil Gas Survey

Three soil gas samples were taken from CS-C. The highest total volatile organic analysis was 1.5 mg/l.

Surface Water

Four surface water samples were collected from the portion of Dead Creek to the south of CS-B. Figure 22 gives the locations and total organic compound concentrations in Dead Creek. As can be seen in Figure 22 two surface water samples were taken from both CS-C and CS-D. No volatile or semi-volatile organic compounds, pesticides, or PCBs were found in Creek Sectors C and D. Lead was found in Sample SW-07 (CS-C) at a concentration of 710 mg/kg.

Sediment

Eight sediment samples, four in both CS-C and D, were taken from the peripheral Dead Creek area. Figure 22 gives the location of the sediment samples. No volatile organic compounds were identified in any of the eight sediment samples. Several semivolatile organic compounds were detected in the sediment samples. Semivolatile organic compounds identified in CS-C and CS-D include phenol, dichlorobenzene and trichlorobenzene and polycyclic aromatic hydrocarbons. Polycyclic aromatic hydrocarbons detected were phenanthrene, fluoranthene, pyrene, chrysene, and benzo(a)pyrene. The levels of PAHs in the peripheral sectors of Dead Creek were generally higher than from the CS-B samples.

Endrin was found in sediment sample SD25, from CS-C. No other pesticides were identified in CS-C and D. PCBs were detected in five of the eight samples. A total of three PCB congeners, Aroclor-1248, Aroclor-1254, and Aroclor-1260, were identified in the five samples. The two highest PCB concentrations of 11 mg/kg and 9.3 mg/kg were found in samples SD-22 and SD-23, both were Aroclor-1254 and found in CS-C. The PCB concentrations in CS-C and CS-D were generally lower than the sediment concentrations of PCBs in CS-B. Cadmium, nickel, and lead were among the inorganic compounds that were found at elevated levels in the eight sediment samples.

In 1991, IEPA took nine additional sediment samples from CS-D through CS-F. The location of these samples are shown in Figures 24 and 25. Results of the analyses of these

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samples are included in Table 6. Contaminants found include PCBs, endrin, PAHs, arsenic, and cadmium.

B. Off-Site Contamination

Site G

Off-site monitoring wells near Site G are shown in Figure 7. The 1980 sample results of Well G107, which is approximately 50 feet south of the site, indicated organic contaminants including chlorophenol, chlorobenzene, dichlorophenol, dichlorobenzene, and PCBs. Well 107 contained arsenic, barium, copper, lead, and manganese at levels above the IEPA Water Quality Standards in 1981. Well G101 is also located south of Site G and the 1981 results indicate PCB contamination in all three rounds of sampling taken on October 23, 1980, January 28, 1981, and February 1981.

A subsurface sample was taken by IEPA in 1981 just south of Site G from a boring during the development of Well G107.

In 1987, two off-site subsurface soil samples were taken by E & E, just west of Site G. Figure 15 identifies the location of the off-site samples G2-30 and G2-31. Tetrachloroethane was found in both samples and toluene and chlorobenzene were found in sample G2-30. Total volatile organic compounds found in the subsurface soils at G2-30 and G2-31 were 960 mg/kg and 1000 mg/kg, respectively. The pesticide breakdown product 4,4-DDE was identified in both samples at levels of 3073 mg/kg and 3683 mg/kg in G2-30 and G2-31, respectively. No PCB congeners were found in either subsurface samples.

Ground Water

Four wells are located near Site G. These wells are designated EE-05, EEG-101, EEG-104, and EEG-103, and their locations are shown in Figure 16. These wells were sampled (GW-14, GW-15, GW-21, GW-16) in 1987. The results of the off-site ground water monitoring are given in Table 8.

Volatile organic compounds detected in these wells were found in low concentrations with the highest concentration being tetrachloroethane in Sample GW-21 at a concentration of 14 $\mu\text{g/l}$. The only semivolatile organic compound detected in the off-site well was naphthalene in samples GW-14 and GW-16 at 17 $\mu\text{g/l}$ and 8 $\mu\text{g/l}$, respectively. The naphthalene results were estimated because the concentrations found were below the method detection limit. No pesticides were found in off-site wells surrounding Site G. AROCLOR-1260 was the only

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PCB congener found off-site. AROCLOR-1260 was in one (GW-15) of the four wells at an estimated concentration of 14 $\mu\text{g/l}$.

Air Sampling

Off-site air sampling near Site G took place south of the site, and its location is labelled DC-05 in Figure 19 and DC-12 in Figure 20. Both samples contained benzene, however the blank samples also contained benzene. The samples also contained phenanthrene, methylnaphthalene, isophorone, and n-nitrosodiphenylamine. Neither sample contained PCBs. No semivolatile organic compounds were detected in sample DC-12.

In addition to the seven monitoring wells, which were installed during the site characterization investigation, an off-site well inventory identified 73 industrial, private, and public wells within a two mile radius of the site. The location of the wells are shown in Figure 26. Six private wells just downgradient of the site were targeted for sampling. Only five of the private wells were located and sampled. Two private wells (49 and 50) south of the site owned by Paul and Rich Saugel are used for water sprinkling systems. Three wells (70, 71, and 73) are located west of the site. Well number 71 is at the northeast corner of the Village of Saugel Recreational Sports Complex and is used to irrigate the ball fields. Well number 73 is located just north of the residence at 1461 Queeny Avenue and was reportedly installed for de-watering purposes to control basement flooding. Well number 70 is approximately half way between well numbers 71 and 73. Odors were noted during sampling of Well 70. The water removed during well development was containerized and stored on-site until the analysis was complete. Table 8 contains the results off-site downgradient well analyses. The results indicate that ground water contamination has moved off-site.

The results of four private well samples taken by E & E near Site M are given in Table 8. The locations of these wells and the total organic compound concentrations found in these samples are given in Figure 27. Four volatile organic compounds (carbon disulfide, chloroform, toluene and styrene) were identified in the private wells. Inorganic compounds found in the well samples include arsenic and manganese.

C. Quality Assurance and Quality Control

The Quality Assurance/Quality Control (QA/QC) plan for the site was obtained from IEPA. The QA/QC plan covered quality assurance objectives, for measurement of data, sampling procedures, calibration procedures and frequency, analytical procedures for data assessment including accuracy, precision, and completeness. From the files reviewed the plan was

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followed and no problems were encountered with the exception of finding certain compounds in the blanks. QA/QC data was not obtained for the IEPA samples.

D. Physical and Other Hazards

Access is restricted to Sites G, I, M, CS-A and CS-B, which are surrounded by chain-link fence. It is assumed that the chain-link fence restricts access to these sites, however there is a hole under the fence surrounding Site M and CS-B and barbed wire is not present along the tops of most site fences. The water in Sites M and CS-B may present a drowning hazard. The access to Creek Sectors C through F is not restricted. Children have been seen playing in and around the creek. The banks of the creek may pose a falling hazard and the water creates a drowning hazard. Sites H and L are vegetated and flat, since no surface contamination has been observed direct contact with chemicals is unlikely.

PATHWAYS ANALYSES

To determine if nearby residents are exposed to site related contaminants migrating off-site, the exposure components are evaluated in this section. An exposure pathway consists of five elements: A source of contamination, transport through an environmental media, a point of exposure, a route of human exposure, and an exposed population. If any of these elements are missing the exposure pathway is not complete.

Two types of pathways are considered in this section: completed and potential. Complete pathways require that the five exposure elements exist and that exposure has occurred in the past, is currently occurring, or will occur in the future. Potential pathways have at least one of the five elements missing, but the missing element(s) could exist. Potential pathways indicate that exposure could have occurred in the past, could currently be occurring, or could occur in the future. An exposure pathway is eliminated if one or more of the elements are missing and will never be present. Table 9 identifies the completed exposure pathways, while Table 10 identifies the potential pathways. This section will discuss the completed and potential exposure pathways, and some of the incomplete exposure pathways.

A. Completed Exposure Pathways

Ambient Air

Completed exposure pathways for ambient air can come from a variety of sources which have occurred in the past, are currently occurring, and will occur in the future. The

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exposure pathways in the air section, as well as the other pathways, will be discussed by source or sources. The route of exposure to airborne contaminants is inhalation and the exposed population are: residents in Sauget, Cahokia, and East St. Louis; on-site workers; and employees at nearby industries and businesses. The sources will be discussed in order of anticipated contribution with those expected to contribute the most, discussed first.

Surface wastes and contaminated surface soils on Site G contribute to airborne exposure. During site visits along the north fence line of Site G along Queeny Avenue, which was downwind of the site, various chemicals odors including PCBs could be detected. The highest exposure in the past would likely have been to volatile organic compounds in on-site wastes.

Surface soil at Site G has been and continues to be a source of airborne exposure. This exposure will continue in the future until the surface soil at Site G is remediated. Volatile organic contamination in the past would be expected to be much higher than it is now, thus causing greater past exposures.

Airborne exposure from surface contaminants at Site G include PCBs, naphthalene, 2-nitroaniline, and fluoranthene. Possible on-site contaminants from Site G that contribute to the airborne concentrations of contaminants include: benzene, isophorone, 2-methylnaphthalene, fluorene, N-nitrosodiphenylamine, pyrene, chromium III, copper, lead and zinc.

Benzene was identified in all the air samples taken on both days (July 16 and 17, 1987), however it was also found in the blanks. The results of air monitoring downwind of Site G ranged from 51 to 118 $\mu\text{g}/\text{m}^3$ above background. Background levels of volatile organic compounds have been identified for the Sauget area (Sweet 1991). The monitoring site was located on Kerr McGee property at Little Avenue and 19th Street in Sauget. Samples were collected from the period between May 1986 and April 1990. The location of this monitoring site was east of Site I. The background benzene concentration fluctuated, but was usually between one $\mu\text{g}/\text{m}^3$ and 2 $\mu\text{g}/\text{m}^3$ over a 24 hour period. It appears that the benzene concentrations identified in the samples may be background and Site G may contribute little to the airborne concentration when compared with other sources including automobiles and area industries. In addition, isophorone and 2-methylnaphthalene were found at or near background concentrations. Two other compounds, pyrene and N-nitrosodiphenylamine were not found in on-site surface soils. Fluorene may have originated from Site G. It was found in 1 of 43 surface soil samples at a concentration of 1.5 ppm. Inorganic compound contributions by Site G may be occurring.

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Compounds that appear to be coming from Site G are PCBs, fluoranthene, 2-nitroaniline, and naphthalene. PCBs were found at very high concentrations in the soil with highest Aroclor concentration being Aroclor-1254 at 29,000 ppm. Aroclor-1260 was detected in 36 of 43 surface soil samples. Air monitoring downwind of Site G identified Aroclor-1248 (6/6), 1254 (2/6) and 1260 (2/6) in the six samples, the number in parentheses is the frequency of detection. There are no comparison values for PCBs in air.

Naphthalene and fluoranthene were found in 11 of 43 surface soil samples taken from Site G. Naphthalene was identified in two of six air samples downwind of Site G with the highest concentration being $0.2 \mu\text{g}/\text{m}^3$. Fluoranthene was identified in one of six samples downwind of Site G with an estimated concentration of $0.01 \mu\text{g}/\text{m}^3$. 2-nitroaniline was identified in these six samples one time at a concentration of $0.44 \mu\text{g}/\text{m}^3$. 2-nitroaniline was identified in four of 43 samples with the highest surface soil concentration of 220 ppm.

The exposure points for surface soil are the same as for surface wastes from Site G. The exact contribution of the surface soils versus surface waste to the airborne contamination has not been estimated; however, combined they probably account for the majority of contaminants in the ambient air around Site G.

In the past, exposure to a wide array of chemicals would have occurred when Sites G, H, I, and L were active sites. Exposure of area residents to chemical wastes from Sites H and I would have continued until these sites were capped. Landfill workers at Sites G, H, and I would have been exposed during the period when they were being filled.

Exposure to contaminants at Site G is currently occurring, although exposures to airborne contaminants would have been higher for anyone walking on-site, prior to fencing it. Individuals that are exposed are workers at Wiese Engineering next to Site G and Cerro Copper, which is just north, across Queeny Avenue from the Site G, and to down wind residents. No air dispersion modelling has been performed to determine the residents exposed. Air monitoring was performed around Site G with 16 compounds being identified.

Future exposures from the surface wastes will continue until Site G is remediated. The exposed individuals will be the same as those that are currently being exposed. Additional future exposure will occur when remediation activities begin. During remediation, residents and employees at nearby industries and businesses may be more highly exposed than the on-site workers, since on-site workers will be wearing protective clothing.

Sauget Sites Area 1 Public Health Assessment - First Draft

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Completed exposure pathways from volatilization of compounds from subsurface soils has occurred in the past and is currently occurring. The compounds that would be available for exposure from undisturbed subsurface soils would be volatile organic compounds to the air. The amount of volatilization from subsurface soil is not known and no modelling has been performed. Exposure to volatile organic compounds from undisturbed subsurface soils would occur to nearby residents and workers.

Soil gas samples were taken from G, H, I, L, M, and Creek Sectors A, B, and C. The soil gases were measured in mg/l of organic vapor without specific compounds being identified. The primary purpose of soil gas analyses was to locate areas of subsurface contamination and were used later as a guide for the actual subsurface core sampling locations. The locations and concentrations of soil gases are given in Figures 9 and 10. CS-C and Site M contained relatively low levels of soil gases and no further discussion of soil gases or subsurface soil contamination at CS-C or Site M will be discussed in this section.

Eleven soil gas sampling locations were taken on Site G. It appears that only a limited amount of subsurface volatile organic compounds are present at the site. Subsurface soil contamination of Site G volatile organic compounds found on site and the frequency detected are: trans-1,2-dichloroethene (1/12), chloroform (1/12), 1,2-dichloroethane (1/12), 2-butanone (11/12), trichloroethane (4/12), benzene (7/12), 4-methyl-2-pentanone (4/12), toluene (6/12), and chlorobenzene (10/12). The contribution of these volatile organic compounds to subsurface soil gas is less than might be expected. CS-B had seven soil gas locations sampled with only two areas near Queeny Avenue (See Figure 9) substantially above background concentrations.

Sites H, I, and L all had high soil gas organic concentrations. This finding parallels the history of these sites being used for subsurface disposal. Subsurface soil samples identified volatile organic compounds at all three sites.

Site L had 10 soil gas sample locations tested (See Figure 9) with five of the 10 being at levels well above the background level. These samples were located in the northern end of the site. This coincides, for the most part, with the soil gas samples. Volatile organic compounds identified in subsurface soils and their frequency of detection at Site L are: chloroform (3/5), 2-butanone (3/5), benzene (4/5), 4-methyl-2-pentanone (4/5), and toluene (4/5).

Site I, and Creek Sector A had 19 different soil gas sample locations. Six locations had soil gas concentrations above 1000 mg/l and one substantially above background at 92 mg/l. Figure 10 gives the location of these samples and their soil gas concentrations. The southern

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section of CS-A had three samples with soil gas levels above 1000 mg/l. The area of Site I with high soil gas concentrations was the southern portion along Queeny Avenue.

Subsurface contamination of Site I only moderately coincides with the areas of high soil gas contamination. Volatile organic compounds that are present at Site I and those compounds that individuals may be exposed to are: trans-1,1-dichloroethene (1/16), 2-butanone (15/16), 1,1,1-trichloroethane (2/16), dichloroethene (2/16), benzene (10/16), 4-methyl-2-pentanone (2/16), xylene (11/16), and chlorobenzene (6/12).

Site H had 12 soil gas samples taken, six of which had organic vapor levels greater than 1000 mg/l. Five of these areas were in the northern boundary along Queeny Avenue with the sixth in the southern portion of the site (see Figure 10). These organic concentrations coincided very well with subsurface soil organic contamination found in subsurface soil samples. Volatile organic compounds found in the subsurface soil which may be constituents of the organic soil gases include: chloroform (2/11), 1,2-dichloroethane (1/11), 2-butanone (5/11), trichloroethane (1/11), benzene (7/11), 4-methyl-2-pentanone (4/11), toluene (5/11), and chlorobenzene (6/11).

Past, present and future exposures to volatile organic compounds from disturbed soils is a completed pathway. There are examples of past exposures to subsurface organic compounds at Site I. These exposures have been documented and have surely occurred in other areas. Disturbing subsurface soils releases volatile organic compounds by volatilization and may release soil bound contaminants, as well. Those exposed to airborne contaminants from disturbed subsurface soil would be those persons disturbing the soil, nearby industrial workers, employees at nearby businesses, and residents.

Exposure to airborne contaminants via sediments would occur from Creek Sectors B through F. Contaminants may be released into the air from both volatilization of compounds in sediments exposed to the air and when sediments dry, via dust generation from these areas. Since Dead Creek is an intermittent water way, sediment dries frequently, especially during the dry months and during periods of drought. Site M has always contained water, thus the sediments are not exposed to air.

Exposure to airborne contaminants from sediments in the past would not only have occurred from CS-B through CS-F, but also from CS-A, which until recently had not been remediated. CS-A may have presented significant exposure due to gross contamination of sediment. Most exposure to airborne contaminants from sediments would occur during the dry months for wind blown silt and warm months for volatile organic compounds, therefore both occur mostly during the summer. This is also when residents spend more time outdoors and have

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windows open. Workers disturbing the sediments primarily from CS-A and CS-B would expose themselves, nearby residents, and industry and business employees.

Current exposure to airborne contaminants from sediments would come during periods when the sediment was exposed to air in Creek Sectors B-F. Sediment contaminants in CS-B through CS-F include PCBs. Since PCBs bind tightly to soil particles, dry silt may contribute significantly to airborne PCB levels. Exposed individuals to airborne contaminants from sediment contaminants in CS-B through CS-F would be the residents of Sauget and Cahokia, especially those whose yards abut those creek sectors.

Future exposures to airborne contaminants from CS-B through CS-F sediments will probably be the same as they are currently. As with surface waste and soils, remediation may potentially increase airborne exposures. This exposure during remediation may be much higher than it is now. Future exposed populations are residents during periods when sediments are exposed or when sediments are disturbed during remediation. Worker exposure may also occur when sediments are being removed.

Exposure to airborne contaminants from surface water would involve volatilization of compounds from the waters' surface. The compounds involved would be the volatile organic compounds. Past exposures surely occurred from contaminated Creek Sectors, Site L, and possibly Site M. Past exposure would have involved workers in the vicinity of these sites as well as nearby residents.

The surface water volatile organic compounds identified in Area 1 during the site characterization were primarily in CS-A. Site M contained 47 ppb chloroform and CS-D contained an estimated benzene concentration of 1 ppb. Exposure to volatile organic compounds from surface water at the present time is considered to be limited if it occurs at all, since CS-A has been remediated and the concentrations in the other surface water bodies is low. Exposure to airborne surface water contaminants at Site L discontinued when the pond was filled.

Future exposure to airborne contaminants from surface water is not expected to be significant if it occurs at all.

Past operation of the landfills and waste disposal Sites G, H, I, L and CS-A and B would have exposed the site operators, nearby workers and residents to airborne contaminants. Exposures occurring during disposal at Sites H and I would have continued from the time waste disposal began to the time the sites were covered. Exposure to airborne contaminants

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from Sites G and L began when the first wastes were disposed at those locations, and continued up to the time the site operations were discontinued.

None of the sites are currently being used, so there is no exposure from site operations at the present time. Future exposures from site operations/remediation have been discussed in the soil and subsurface soil sections.

Area industries may contribute significantly to airborne contaminants. The source of these contaminants may include known releases (TRI), releases from the surface soil, accidental releases and spills and subsurface soils. The Toxic Release Inventory indicates that there are four industries that contribute to airborne contaminants (Table 1). Of these industries Monsanto and Cerro Copper release the largest quantities. Some of the contaminants of concern released in large quantities include: benzene, ethylbenzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, xylenes, 1,1,1-trichloroethane, trichloroethene, lead and cadmium.

Air sampling was performed on or adjacent to Sites G, I and CS-B on two days in July 1991. The air sampling was designed to identify both volatile organic compounds and particulate bound compounds. A background sample was taken of the sites. Table 5 contains the air sampling results from Area 1.

Benzene was the only volatile organic compound found in air samples. Benzene was found in the blank samples at concentrations of $15 \mu\text{g}/\text{m}^3$ and $17 \mu\text{g}/\text{m}^3$. In addition, benzene was found in the background samples at concentrations of $70 \text{ mg}/\text{m}^3$ and $75 \text{ mg}/\text{m}^3$. Benzene in the background samples indicate that even if the benzene results are reliable it may not originate from any of the Area 1 sites.

Nine semivolatile organic compounds were identified in the samples. Isophorone was found at an estimated concentration of $0.01 \mu\text{g}/\text{m}^3$ at Site G, however the background sample contained an estimated concentration of $0.02 \mu\text{g}/\text{m}^3$, therefore isophorone may not be a site related contaminant. 2-methylnaphthlene was found on Site G in one sample at an estimated concentration of $0.02 \mu\text{g}/\text{m}^3$ and at Site I at an estimated concentration of $0.03 \mu\text{g}/\text{m}^3$, however the background sample had an estimated concentration of $0.02 \mu\text{g}/\text{m}^3$. Semivolatile organic compounds found on Area 1 air samples are naphthalene, 2-nitroaniline, fluorene, n-nitrosodiphenylamine, fluoranthene, and pyrene. The other semivolatile organic compounds were all found on Site G and fluorene was detected at Site I. PCBs were found at Site G in all six samples. They were found at the monitor at CS-B in one of the two samples.

Sauget Sites Area 1 Public Health Assessment - First Draft

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Metals found in the samples were chromium, copper, lead, and zinc. Chromium was only found in one sample on Site G and is not considered to be significantly above background. Copper, lead, and zinc were found in all samples at all three sites as well as in both the background samples. The highest background sample for those three metals was lower than those downwind of the sites.

Meteorological data was taken at the time of sampling. The wind direction indicates that the background sample was indeed upwind of the Area 1 sites. In addition, area industries were downwind of the sites so that their contributions were eliminated. The results of the air sampling indicate that the Area 1 sites, especially Site G are contributing to airborne concentrations of PCBs, naphthalene, 2-nitroaniline, fluorene, and pyrene. The PCBs in the air on Site G coincide with the very high surface concentrations which have been identified on-site.

Data for contaminants in ambient air in residential areas and those from area industries were not identified. The other Area 1 sites probably do not contribute substantial quantities of chemicals to the air as does Site G. It should also be noted that Sauget Sites in Area 2 may also contribute to airborne contaminants in the Sauget and Cahokia areas.

Sediment

Exposures to sediments in CS-A through CS-F and Site M have occurred in the past. Table 6 lists the contaminants in sediments found at Area 1 sites. In addition to the sediments at Site M and the creek sectors, Site L once was a disposal pond prior to being filled in. The past completed exposures to sediments would have occurred at Site M and all the Creek Sectors. The routes of exposure to these sediments would be dermal contact, inhalation, and ingestion. Workers would have been most likely to be exposed to contaminants in CS-A and CS-B and since these areas were not fenced, residents may have also come into contact with them.

The sources of contamination of sediment include disposing of wastes into water or directly upon exposed sediments, contaminated wastes and soils running into the creek or body of water, airborne deposition of contaminated surface water, or seeping of contaminated ground water into the sediments.

Past exposures to workers and possibly residents at CS-A, which has been remediated can be estimated from the results found in Table 6.

Sauget Sites Area 1 Public Health Assessment - First Draft

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No volatile organic compounds were found in CS-A and CS-B at levels above their soil comparison values. Though volatile organic compounds were found in CS-A and in CS-B that did not have comparison values were 2-butanone, 4-methyl-2-pentanone, and 2-hexanone. Of these 2-butanone and 4-methyl-2-pentanone were found in blank samples analyzed at the same time. These blank samples would not be expected to contain any volatile organic contaminants, thus 2-butanone and 4-methyl-2-pentanone may be laboratory contaminants. Volatile organic compounds may have been more numerous and at higher concentrations in the past.

Of the semivolatile organic compounds only one was found in sediments at concentrations that were higher than its comparison value and that was benzo(a)pyrene. Benzo(a)pyrene was found at levels in CS-A sediments ranging from 0 - 0.54 mg/kg, and from 0.95 - 1.80 mg/kg at CS-B. Seventeen compounds were detected in sediments in one or both of the samples taken from CS-A and CS-B.

No pesticides were identified in either creek sector, however PCBs were found at high levels in both sections. Workers and other persons contacting the sediments would have been exposed to PCBs.

Metals that exceeded their comparison values at one or both creek sectors are arsenic, cadmium, barium and silver. Six metals were detected but did not have comparison values for soil.

Past exposures in Creek Sectors C-F and Site M would have occurred and involved primarily residents in the area since these areas are bounded by residential areas. The Creek Sectors C-F which are contaminated with several compounds including PCBs are easily accessible by children. The source of the PCB contamination is presumably from surface soils at Sites G, and sediments from Creek Sectors A and B, prior to blocking their discharge to the lower creek sectors.

Present exposure to contaminated sediments is still occurring in Creek Sectors C - F. Children have been observed playing in the creek bottoms in Sectors CS-C and CS-D in the past. Since there is no barrier to prevent them from accessing these areas, they will continue to play in these sediments. As with past exposures to sediments, children would be exposed to PCBs and metals.

Creek Sector A has been remediated and thus exposure to sediments in this area has been eliminated. Creek Sector B and Site M have been fenced in to prevent access, however there is a hole under the fence at the southern portion of Site B along Judith Lane. The conduit

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under Judith Lane connecting CS-B and CS-C has been blocked preventing contaminants from Creek Sector B from entering CS-C. Access to CS-B and Site M by children going underneath the fence probably is continuing at the present time.

Exposure to sediments in the future will remain the same as they are today, if no action is taken. Changes in the future may be instituted to reduce exposure including repairing the fence at Judith Lane to prevent access to CS-B and Site M, fence or remediate CS-C through CS-F. Remediation of CS-B and Site M would be another method of reducing or eliminating exposure to sediment contaminants at these sites. Future remediation of sediments may result in exposures to residents, workers, and area employees.

Surface Water

Exposure to surface water contaminants can occur in several ways including consumption of drinking water, accidental ingestion and absorption through the skin while playing or swimming in surface water, and inhalation of volatile contaminants from surface water. Surface water in Area 1 of the Sauget Sites can be found at Site M and Creek Sectors A-F. Past exposures may also have occurred from Site L prior to being filled. The surface water in the creek sectors are intermittent. None of the surface water is used as a drinking water supply. The creek sectors drain into the Prairie DuPont spillway, which empties into the Mississippi River. Possible exposure routes include ingestion, inhalation, and dermal contact.

Past exposures to surface waters would have included worker exposure at CS-A, CS-B, Site L, and Site M. Since Dead Creek is an intermittent stream, exposures would not have occurred year round. Worker exposure to surface water in CS-A may have occurred with some regularity, since several industries dumped in and around the area. Worker exposure at CS-B would have been sporadic. Site L was a surface impoundment used to collect rinsate from waste hauling trucks. Exposure to surface water at Site L may have occurred mostly via inhalation with some direct contact, but probably not by accidental ingestion. The concentrations of contaminants in surface water at Site L at the time of operation are not known. Worker exposure to surface water at Site M may have occurred occasionally, however it does not appear that Site M was used for waste disposal. Site related contaminant concentrations at Site M are generally lower than other Area 1 surface waters. Worker exposure at CS-A and B would be via inhalation and dermal contact.

Past residential exposure to surface water, like exposures in workers, may have occurred by inhalation and dermal contact with the incidental or accidental ingestion occurring. Exposure

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to surface water contaminants at CS-A and CS-B as well as Site L was probably by inhalation of chemicals, which volatilized from the water. Direct contact probably did not occur at CS-A, the northern portion of CS-B and Site L with any regularity, since they are industrial areas, which have workers in the area during the day time hours. Exposure to surface water contaminants in the southern portion of CS-B and CS-C through CS-F and Site M by area residents and especially children has occurred in the past. Children playing in the creek sectors would be exposed by direct contact to surface water as well as inhalation and accidental ingestion. Exposure to contaminants at Site M probably would not result in a significant exposure to any compounds (based on the data), unless there were higher concentrations of contaminants at the site in the past.

Current exposure to surface water in Area 1 will no longer occur at Site L, since no surface water exists at the site. CS-A has recently been remediated and should not have contaminated surface water. Exposure to surface water at CS-B and Site M should not occur, however there is at least one area of fencing where children and others may enter this area. For individuals entering CS-B and Site M exposure would be similar to past exposures. Exposure to contaminants at Site M would not be significant since the only contaminant identified in the surface water at levels above the drinking water standards was manganese. Exposure to surface water contaminants at CS-B would be from dermal contact and accidental ingestion. No volatile organic compounds were identified in surface water at CS-B above the drinking water standards. PCBs were found in the surface water at CS-B with the highest concentration being 44 ppb. Nitroaniline was found at an estimated concentration of 9 ppb. The other contaminants at CS-B were all inorganic compounds. Inorganic compounds detected at CS-B at concentrations at or greater than the drinking water comparison value are arsenic, barium, cadmium, copper, lead, manganese, nickel and zinc. Exposure to inorganic compounds at CS-B would be by accidental ingestion and is not considered to be significant.

Exposure to CS-C surface water has been observed. Exposure to surface water contaminants at CS-C through CS-F would be similar to CS-B exposures. Surface water analyses have not been performed on CS-E and CS-F, presumably because of low numbers and concentrations of contaminants in surface waters in CS-C and CS-D. Organic contaminants in CS-C and CS-D consisted of 1.0 ppb benzene in CS-D and 1.0 ppb diethylphthalate in CS-C. All other detects in sampling were inorganic compounds. The inorganic compounds found at levels above the drinking water comparison values were cadmium, lead, manganese, nickel and zinc.

Future exposures to surface water will be the same as those that are now occurring, unless access to the creek sectors is restricted or they are remediated.

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Surface Soil

Surface soil contamination in Area 1 occurs primarily at site G and possibly along the banks of Dead Creek. In the past, soils in and around CS-A were contaminated, however they have since been remediated. Surface soils at Sites L, H, and I had been removed prior to waste disposal and were covered with clean material. Exposure to contaminated surface soil includes direct contact, inhalation via wind blown dust and volatilization, and accidental ingestion.

Past exposures to contaminated soil by workers would have occurred at Site G, Site L in spill areas, and in CS-A and CS-B. Exposure to surface soil contaminants at Site L would occur sporadically as the whole surface probably was not contaminated. Exposure to surface soils at CS-A and CS-B would have been similar to those of the sediments in these areas. Exposure to Site G surface soils including wastes lying atop the soils' surface may have been quite high during the period of surface disposal. Even after the site was abandoned, exposure by airborne contaminants from the site would have occurred. Exposure to contaminants at Site G would have taken place by direct contact with soil and wastes, inhalation, and possibly by accidental ingestion by eating or smoking prior to washing their hands. Workers may have also been exposed to CS-B surface soils which may be contaminated by overland flow from Site G.

Past residential exposure to surface soils along Dead Creek would probably be confined to contaminant deposition from creek overflow. No sampling has been performed on these creek bank soils.

Worker exposure by direct contact to contaminated soils at CS-A and Sites H, I, and L should no longer occur in and around CS-A since it has been remediated and Sites H, I, and L having been covered with uncontaminated materials. Access is not allowed to Site G without protective clothing. Workers in areas near Site G may be exposed to contaminated air from Site G. In the air section, Site G was positively identified as having contributed to the airborne contamination, including PCBs. Residents are now exposed to essentially the same contaminants from surface soils as they were in the past, however volatile organic compound concentrations may have been higher in surface soils in the past. Without remediation, exposure (primarily from Site G) will continue in the future.

Sauget Sites Area 1 Public Health Assessment - First Draft

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Subsurface Soil

Exposure to contaminated subsurface soils would have occurred to workers in the past by direct contact with the soil, inhalation of contaminants from exposed soil, and possibly by accidental ingestion.

While digging or disturbing contaminated subsurface soil nearby, workers and residents would be exposed primarily by inhalation of compounds volatilized from the subsurface soil. Subsurface soils at Sites G, H, I and L are contaminated and the subsurface soil at CS-A was contaminated. It is assumed that there is at least some contamination underneath CS-B through CS-F. However, the lower sectors of the creek may not have contaminated subsurface soils. Contaminant to other area workers and residents probably occurred during remediation of CS-A surface and subsurface contamination. Worker exposures to contaminants during remedial activities may have been greatly reduced or eliminated by wearing protective clothing.

Current exposure to subsurface soil contamination may occur by volatilization of contaminants from disturbed areas. In addition, contaminated soil gas may slowly be released into the atmosphere from subsurface areas.

Ground Water

Ground water has only been known to be used for watering gardens in recent years. The communities and industries in the area use municipal water. Ground water contamination occurs beneath and in areas surrounding the sites, especially Sites G, H and I. Private wells have also shown contamination.

Past exposures may have occurred if excavations were made into the water table which is close to the surface. The other source of past exposures would be from using ground water wells. The ground water contaminant exposure may have been from ingestion, inhalation and direct contact. Ingestion of contaminants may have also occurred indirectly by watering gardens with contaminated ground water.

Present exposure may occur to those residents who have ground water wells. Some ground water wells have been identified, but there may be others since the wells can be constructed with relative ease by the homeowner. The residents who currently have wells that have been identified by IEPA have been warned about using the water. Since all the surrounding communities have municipal water taken from the Mississippi River, no ground water should be or needs to be used. Contamination of the ground water is extensive. Future exposure to

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ground water should not occur except for the possibility of exposure via contact or inhalation during excavation.

Biota

Residents have stated that they use their wells to water their gardens. Contaminants in the well water may be taken up by the plants and subsequently ingested by any eating the plants.

The completed exposure pathways are listed in Table 9. The pathways that are considered to contribute or may contribute significantly to current exposures are inhalation of airborne contaminants and dermal contact to creek sediments. The source of airborne contaminants are primarily volatile organic compounds and PCBs on the surface at Site G and air releases by area industries. Exposure via direct contact with contaminated sediments in CS-B through CS-F is primarily to PCBs, inorganic compounds, and polycyclic aromatic hydrocarbons. Exposure to contaminants in surface water would include PCBs in CS-B. Future completed pathways that may be of concern are worker and resident exposures to contaminants in subsurface soils and groundwater that may become airborne during remedial activities. In addition, future on-site workers may come into direct contact with surface soils, subsurface soils, and contaminated ground water.

B. Potential Exposure Pathways

Ambient Air

Potential exposures to airborne contaminants may occur from soil gases, ground water, and future remedial activities in Area 1. Volatile organic compounds would be the most common contaminant in soil gases. The sources of these contaminants would be contaminated subsurface soil and ground water. The contaminants would have to volatilize into soil gases and from there migrate to the grounds' surface where they would be released to the atmosphere.

Another potential source of exposure to site contaminants in the air would be contaminated soil gases entering homes, especially in basements. Contamination may occur in the residences above contaminated plumes of ground water. The contamination plumes are not currently known to be beneath any residential areas, but they may move there in the future.

Disturbing soil during remediation or other activities in areas with subsurface contamination may occur in the future. Exposing contaminated soil and ground water to the air would allow some contaminants to be released into the air.

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Removal of sediments by workers may release volatile organic compounds. In addition, if the sediments are dry they might also produce contaminated dust. Exposure to airborne contaminated sediment in this way would only occur if remediation involves removal of sediment.

Sediment

Potential exposure to airborne sediments that are disturbed were discussed in the previous section. Exposure to contaminants from sediments may occur to workers coming into direct contact with sediments at Site M and CS-B through CS-F. One of the primary contaminants in sediments is PCBs, which are present at levels above 10 ppb in several creek sectors. Another potential exposure would be to sediments in CS-A, if they were re-contaminated from ground water and then workers came into contact with them.

Surface Water

No potential exposures to surface water were identified. Contaminated surface water may contaminate other media; for example infiltration of surface water to ground water or over land flow which would contaminate soil. There is an exchange of some contaminants between surface water and sediments.

Surface Soil

Potential exposures to surface soils would occur in workers remediating Site G. Another potential source of exposure would be contamination of surface soils from another media and subsequent exposure to this soil. Other media that might contaminate surface soils include runoff water from contaminated areas and contaminated ground water rising to the ground surface, and air deposition.

Subsurface Soil

Potential exposure to subsurface soils may occur in workers remediating Sites G, H, I and CS-B through CS-F. Exposures in residents may occur from disturbing contaminated subsurface soil. Resident exposure to direct contact of contaminated soils is unlikely unless the subsurface contamination spreads to residential areas. Residents would probably be exposed to contaminants from subsurface soils when soils are removed during remediation.

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Ground Water

Potential exposure of residents to contaminated ground water may occur in a number of ways including installation of a new well into an area with contaminated ground water or having an existing well where a plume of contaminants would move into the area. These exposures would occur in the same manner as residents currently having wells, which would include drinking, direct contact with the water, inhalation of volatile compounds when the water was used, and watering gardens with contaminated ground water with subsequent ingestion. The compounds that residents would potentially be exposed to are those found in subsurface soils and ground water.

Workers may also potentially be exposed to ground water contaminants if they were working at or below the water table in areas with contaminated ground water or if they install a well in an area of contamination. Exposure could occur from inhalation of contaminants, direct contact with ground water, and possibly by ingestion.

Biota

Biota that may be contaminated from sites may include vegetables that are watered with contaminated ground water, and consumption of migratory waterfowl and possibly fish in the Prairie DuPont spillway or Mississippi River. Waterfowl may use parts of the creek when they contain water.

Potential sources of exposure via animals would be from ingestion of contaminated specimens. Potential exposure could occur if contaminants for the creek sectors are reaching the Mississippi River and are being accumulated in fish. Waterfowl may ingest contaminated sediments or drink contaminated water and accumulate contaminants in their flesh. This probably would not be significant since Dead Creek is an intermittent stream.

A summary of potential exposure pathways are listed in Table 10. Most of the potential exposures would result from future exposures during remedial activities. Exposures from remedial activities would more likely occur to nearby residents and unprotected workers in nearby industries and businesses. On-site remediation workers would not be expected to be exposed to a significant level of contaminants from the sites since they will be wearing protective clothing.

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PUBLIC HEALTH IMPLICATIONS

A. Toxicological Evaluation

This section will include discussions on the health effects in persons exposed to specific site related contaminants, evaluate any applicable state and local health databases, and address specific community health concerns. To evaluate health effects, Minimal Risk Levels (MRL) have been developed for compounds commonly found at hazardous waste sites. An MRL estimates the daily human exposure to a contaminant below which adverse, non-cancer, health effects are not likely to occur. MRLs are developed for different routes of exposure, including ingestion and inhalation, and for three different exposure periods, acute (less than 14 days), intermediate (15-365 days), and chronic (more than 365 days).

ATSDR has developed Toxicological Profiles for contaminants that are common at hazardous waste sites. The Toxicological Profiles are specific for individual chemicals. The Toxicological Profiles used in this discussion are: benzene, 2-butanone, 2-hexanone, 4-methylphenol, 1,4-dichlorobenzene, naphthalene, phenanthrene, fluoranthene, benzo(a)pyrene, methylphenol, endrin, PCBs, arsenic, barium, cadmium, manganese, and zinc. The profiles contain information on health effects, environmental transport, human exposure, and regulatory status of each of the chemicals.

Polychlorinated Biphenyls

Exposure to polychlorinated biphenyls (PCBs) is known to occur in two different media and two different populations. Airborne exposure occurs in employees working in businesses and industries in the vicinity of Site G. The workers that would have the greatest exposure would be those closest down wind, especially during the warm months when volatilization would be the highest. During warm weather the prevailing winds are usually south or southwesterly. Cerro Copper is due north of Site G and workers there would be exposed especially during the summer. In addition, Monsanto is located just north of Cerro Copper, Weise Engineering Company along the northwest boundary of Site G, Metro Construction just to the east with Keely Construction east and south of Metro Construction. The Sauget Village Hall is one block northeast of the site. The nearest residence is within one third of a mile east of the site.

The highest airborne concentration of PBCs was $0.5 \mu\text{g}/\text{m}^3$. The sample site was located on Site G just across the street from Cerro Copper. Currently there are no comparison values for PBCs in air for non-occupational exposures. OSHA's permissible exposure limit (PEL) is $1 \text{ mg}/\text{m}^3$ for chlorodiphenyl (42 percent chlorine) and $0.5 \text{ mg}/\text{m}^3$ for chlorodiphenyl (54

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percent chlorine). Although the workers at Cerro Copper, Weise Engineering, and other locations are exposed to these PCBs occupationally, they would not normally be expected to be exposed in these occupations. The occupational exposure limit in these cases would not be applicable.

Exposure to PCBs in the creek sediments is known to occur in creek sectors south of CS-B. PCBs were found in all creek sectors sediments. Recent IEPA sampling revealed PCB levels in sediments at concentrations as high as 60 ppm in CS-F. Exposure would take place when children play in sediments. The chronic EMEG for soils is 0.01 ppm for the pica child and 0.3 ppm for a non-pica child. A pica child is defined as a child that eats nonfood items. The levels found throughout CS-C through CS-F sediments are above this level. Exposure to sediments would not occur with the same frequency as in soil, however the exposure to the sediments could be significant.

Exposure to PCBs in and around the sites would be by inhalation, ingestion, and dermal contact. The amount of absorption by each route is not known in humans. Absorbed PCBs are stored in fat. Since PCBs are distributed to fat, the fat in breast milk is a source of exposure in infants. PCBs may be transferred from the mother to the fetus through the placenta.

The health effects of PCB exposure in humans may include chloracne and possible learning difficulties in children whose mothers were exposed during pregnancy. Health effects associated with PCB exposures in animals include liver, stomach, and thyroid gland effects, anemia, acne, and reproductive system damage. The effects have been seen in offspring of animals exposed to PCBs. There is limited evidence that PCBs are a liver carcinogen in animals.

The exposure to PCBs from either air or sediments would not be expected to cause chloracne in either employees or residents. The health effects that have been seen in animals have not been observed in humans. PCBs are considered to be a probable human carcinogen by USEPA.

Volatile Organic Compounds

Benzene is the primary volatile organic contaminant of concern in Area 1, however other volatile organic compounds of concern in Area 1 are 2-butanone, 4-methyl-2-pentanone, and 2-hexanone. These volatile organic compounds were all found in sediments. They were not detected in air samples or the private wells. The primary concern with volatile organic

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compounds in sediments is exposure to residents and nearby workers from volatilization from either exposed sediments or surface water.

Benzene

Exposure to benzene from site related contamination may occur, however exposure to non-site related sources may be much greater. Toxic release inventory (TRI) data for Monsanto and Big River Zinc show annual releases of benzene to be 28,800 pounds and 2,405 pounds respectively. The majority of volatile organic chemicals released in the Sauget area come from Monsanto and other nearby industries (Sweet, 1992).

Air monitoring around Site G included benzene. The results of this sampling indicated benzene levels of $15 \mu\text{g}/\text{m}^3$ and $17 \mu\text{g}/\text{m}^3$ in the blank samples. Additionally, background samples were taken which contained benzene concentrations from 70 to $75 \mu\text{g}/\text{m}^3$. Benzene concentration ranges identified downwind of the site were slightly higher than the background. The downwind concentrations were between $51 \mu\text{g}/\text{m}^3$ and $118 \mu\text{g}/\text{m}^3$. Benzene in surface soil was detected in only three of 43 surface soil samples. Benzene has not been found in private well samples. Benzene was detected, at an estimated concentration of 1 ppb, in a surface water sample in CS-D.

Exposure to site related benzene would primarily occur in residents and employees of local businesses and industries at low levels. At these levels the primary concern would be chronic exposure. Some health effects of long-term benzene exposure would be blood disorders, immune system effects, and cancer. The blood disorders include bone marrow damage and decrease in red blood cells and other blood components. The immune system effects are related to bone marrow damage. Benzene is listed as a known human carcinogen. Long term exposure to high levels of benzene can cause leukemia.

2-Butanone

2-butanone is a volatile organic compound whose main health effects in humans who breathed it at higher concentrations are mild irritation of the nose, throat, eyes, and skin. 2-Butanone alone does not have serious effects on the liver or nervous system, but it can cause other chemicals to become more harmful to these systems. 2-butanone was found in sediments at Site M and CS-A through CS-D, but was not identified in CS-E or CS-F. 2-butanone was not found in air samples near Site G, however it was identified in 25 of 43 surface soil samples from Site G. No comparison values were available for 2-butanone. Exposures to 2-butanone would be from inhalation, dermal contact with the contaminated sediments, and accidental ingestion of sediments.

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2-Hexanone

2-hexanone was detected in CS-A through CS-D. It was also detected in 22 of 43 surface soils at Site G, however it was not detected in the air samples. 2-hexanone was not reported to be released by any of the area industries. 2-hexanone exposure would be by inhalation, ingestion, and dermal contact with sediments. No health comparison values were available for 2-hexanone.

There is no information on human health effects associated with 2-hexanone inhalation. The animal data on 2-hexanone inhalation is for an intermediate time period and at higher levels than the concentrations either on or off site. Rats exposed to 2-hexanone via inhalation at a concentration of 100 ppm for six months experienced nerve damage. An 11 week rat inhalation study using 700 ppm 2-hexanone caused weakness in legs, decrease in white blood cells, and decreased testes weight. There is no information on health effects from ingestion or dermal contact of 2-hexanone in humans and the available animal data is for exposures that are much higher than site related 2-hexanone concentration.

4-Methyl-2-pentanone

4-methyl-2-pentanone was identified in the sediments in CS-B. It was not identified in air samples. Monsanto listed the release of 30,000 pounds per year of 4-methyl-2-pentanone into the air. Private well samples did not contain 4-methyl-2-pentanone. Exposure to 4-methyl-2-pentanone from the sediments at CS-B would be by inhalation of the volatilized portion. Since access to CS-B is supposed to be a restricted area, residents would not be exposed by direct contact or accidental exposure, however access to CS-B is possible. 4-methyl-2-pentanone was detected in 22 of 43 surface soil samples from Site G. Health effects associated with exposure to this volatile organic compound include eye and mucous membrane irritation, headaches, and dermatitis. It is not currently listed as a carcinogen by USEPA.

Semivolatile Organic Compounds

The semivolatile organic compounds of concern from the site are 1,3-dichlorobenzene, 1,4-dichlorobenzene, 4-methylphenol, naphthalene, fluoranthene, and benzo(a)pyrene. All of the semivolatile organic compounds except fluoranthene were found in the sediment. Naphthalene and fluoranthene were found in air samples, while fluoranthene was identified in private well water.

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1,3-dichlorobenzene

1,3-dichlorobenzene was only found off-site in sediments in CS-A and CS-C. It was not found in the air samples around Site G and was not detected in surface soils at Site G. No off-site ground water samples contained 1,3-dichlorobenzene. Monsanto reported emissions of 330 pounds per year of 1,3-dichlorobenzene. Exposure to 1,3-dichlorobenzene in sediments at CS-C would occur in children playing in and around CS-C. The highest concentration of 1,3-dichlorobenzene in CS-C sediments was 0.11 ppm. 1,3-dichlorobenzene is not normally manufactured and is a contaminant of 1,2-dichlorobenzene and 1,4-dichlorobenzene. No information on the health effects of 1,3-dichlorobenzene were found in a review of the literature.

1,4-dichlorobenzene

1,4-dichlorobenzene was detected in the sediments of CS-A through CS-E. It was also detected in four of the 43 surface soil samples at Site G with the highest concentration at 22,000 ppm. 1,4-dichlorobenzene was not detected in air samples, however according to the Toxic Release Inventory, Monsanto releases 15,800 pounds of 1,4-dichlorobenzene annually. It was not detected in off-site ground water. Exposure to 1,4-dichlorobenzene in sediments would probably occur by direct contact with sediments and ingestion. Children in the vicinity of CS-B, CS-C, CS-D, and CS-E would be most likely to be exposed to 1,4-dichlorobenzene.

1,4-dichlorobenzene is used to produce mothballs and in deodorant blocks in rest rooms. There is no evidence that these everyday exposures in moderate amounts cause adverse health effects in humans. At higher exposures dizziness, headaches, and liver problems have been reported. The exposure from site related 1,4-dichlorobenzene would be expected to be much lower than everyday exposures. 1,4-dichlorobenzene has been linked to an increased rate of cancer in rats and mice. It is unknown if 1,4-dichlorobenzene is a human carcinogen, but the animal data suggest that it may be a human carcinogen. No comparison values were available for 1,4-dichlorobenzene.

4-methylphenol

4-methylphenol or para-cresol was detected in the sediments at CS-F with a concentration of 1.1 ppm. 4-methylphenol was not detected in ground water, air samples, or Site G surface soils. Long term exposures at low levels in animals have indicated nervous system effects including loss of coordination and twitching muscles associated with the exposure. These

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effects have not been noted in humans. Cresols have been shown to be tumor promotions in animals. It is not known whether 4-methylphenol is a carcinogen in humans.

2-nitroaniline

2-nitroaniline was detected in one of six air samples taken at Site G. The concentration was $0.44 \mu\text{g}/\text{m}^3$ in this sample. 2-nitroaniline was detected in only four of 43 samples on Site G with the highest concentration of 220 ppm. 2-nitroaniline was not listed in the Toxic Release Inventory for the Sauget/East St. Louis area. Little toxicological data was found in the literature, however some toxicological information was identified for 4-nitroaniline. The harmful effects associated with 4-nitroaniline exposure include cyanosis, ataxia, tachycardia, tachypnea, dyspnea, vomiting, diarrhea, convulsions, respiratory arrest and anemia. Exposure to 2-nitroaniline would presumably occur via inhalation by nearby employees and residents. No comparison values were available for 2-nitroaniline.

The four remaining semivolatile organic compounds; naphthalene, phenanthrene, fluoranthene and benzo(a)pyrene are polycyclic aromatic hydrocarbons or PAHs. This group of compounds is usually not very soluble in water, binds tightly to soil particles, and can bioaccumulate in plants and animals. PAHs usually exist as mixtures in the environment, rather than in pure form.

Naphthalene

Naphthalene was detected in both air and sediment samples. Naphthalene was found in the air at Site G in two of six samples with the highest concentration being $0.002 \mu\text{g}/\text{m}^3$ or 0.00000004 ppm. The highest airborne concentration detected at Site G is below the typical level for naphthalene in airborne air, which is estimated to be 0.0000001 ppm (ATSDR, 1989). Naphthalene was found in 11 of 43 surface soil samples at Site G and the highest concentration detected was 120 ppm. Naphthalene has the highest vapor pressure of the PAHs, which means that it will volatilize more readily than other PAHs. TRI data for the area indicates that 4,600 pounds per year of naphthalene is released by Ethyl Petroleum Additives. In addition, the combustion of fossil fuel is the major source of airborne naphthalene (ATSDR, 1989). Naphthalene was also found in the sediments in CS-A through CS-C. CS-A is no longer an exposure source since it has been remediated. CS-B had the highest estimated naphthalene concentration in sediments of 9.5 mg/kg. The highest estimated naphthalene concentration in CS-C was 0.33 mg/kg. Naphthalene was also found in ground water underneath Site G.

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Naphthalene exposure in humans at levels well above those levels found at Area 1 sites have caused hemolytic anemia, nausea, vomiting, diarrhea, kidney damage, jaundice, and liver damage. The effects are seen from both inhalation and ingestion. These effects would not be expected to be exhibited from exposure to naphthalene containing sediments in CS-B and CS-C. There is not enough animal or human data to classify the carcinogenicity of naphthalene.

Phenanthrene

Phenanthrene was detected in sediments from CS-A through CS-E. The highest concentration of phenanthrene was 15 ppm at CS-B. The highest sediment concentration in CS-C through CS-F was 0.81 ppm in CS-C sediments. Phenanthrene was not detected in air samples, but was detected on Site G surface soils in 10 of 43 samples with the highest concentration estimated at 40 ppm. Phenanthrene was not detected in off-site ground water. Area industries did not report a release of phenanthrene to the environment. No comparison values were available for phenanthrene.

Fluoranthene

Fluoranthene was detected in air at Site G at an estimated concentration of $0.01 \mu\text{g}/\text{m}^3$ in one of six samples. It was not detected in the air monitors at Site I or CS-B. Fluoranthene was also detected in sediments from CS-A through CS-D. The highest concentration at CS-B was estimated at 11 ppm; at CS-C it was 4.6 ppm, and at CS-D it was estimated at a concentration of 0.51 ppm. The RMEG value for phenanthrene in soils based on exposure in the pica child is 80 ppm. Based on the RMEG for soil fluoranthene concentrations, sediment concentrations do not appear to be a health concern. Fluoranthene is currently not classifiable as a carcinogen according to the International Agency for Research on Cancer (IARC).

Benzo(a)pyrene

Benzo(a)pyrene was found in sediments in CS-A through CS-D. CS-A has since been remediated and no further exposure would be expected from this creek sector. The highest concentration in CS-D was estimated to be 240 mg/kg. No air samples taken in Area 1 contained benzo(a)pyrene. Benzo(a)pyrene was detected in 13 of 43 surface soil samples at Site G with the highest concentration of 22 ppm. No benzo(a)pyrene was detected in off-site ground water. The CREG for benzo(a)pyrene in soils is 0.1 ppm. Benzo(a)pyrene is listed as a B2 carcinogen by IEPA and 2A by IARC. A B2 carcinogen according to EPA definition, is a probable human carcinogen, which means that there is adequate animal data

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but insufficient human data. A 2A carcinogen by IARC definition is reasonably anticipated to be a carcinogen and is based on sufficient animal studies. The sediments in CS-B through CS-D exceed the CREG. The estimated concentration in CS-D of 240 mg/kg is well above the CREG. Children are the primary segment of the population that would be exposed to sediments.

The non-carcinogenic effects of PAHs are based primarily on animal studies where the animals were exposed to much higher levels than those associated with Area 1. Benzo(a)pyrene caused reproductive difficulties in mice and their offspring. These offspring also exhibited birth defects and decreased body weight. Animal studies with other PAHs produced a variety of health effects including adverse effects to skin, body fluids, and the immune system.

Other carcinogenic PAHs found in creek sector sediments include benz(a)anthracene, benzo(b)fluoranthene, chrysene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(cd)pyrene. They were carcinogenic to animals via ingestion, skin contact, or inhalation. All of the above listed PAHs are listed as B2 carcinogens by USEPA. As of March 31, 1993 no carcinogenic comparison values were available for any of these PAHs.

Pesticides

The only pesticide among the contaminants of concern is endrin. Endrin was only identified in sediments from CS-D, CS-E and CS-F. Endrin was not detected in any of the other on- or off-site media which were sampled. The use of endrin was strongly curtailed in the mid-1960's. In 1979, endrin was cancelled for all but a few uses. The source of endrin in the creek sediments may be from past agricultural or residential use. It is an organochloride pesticide. The highest concentrations found in CS-E and CS-F were 0.93 mg/kg and 0.66 mg/kg, respectively. These concentrations exceeded the chronic EMEG for soil of 0.6 mg/kg for a pica child. The chronic EMEG for a non-pica child is 20 mg/kg. Endrin would not be expected to cause adverse health affects in a child unless a pica child plays in the sediments in CS-D through CS-F.

Inorganic compounds

The inorganic compounds of concern associated with Area 1 sites are arsenic, barium, cadmium, manganese, and zinc. Arsenic, barium, cadmium, and zinc were found in sediments at concentrations that are higher than the comparison values for soils. Arsenic, zinc and manganese were present in private wells at levels above their comparison values.

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Background levels of inorganic compounds were not found in the literature. No inorganic compounds were found at levels above their comparison value in air.

Arsenic

Arsenic was found in all the sediment (Site M, CS-A through CS-F) samples at concentrations above the CREG of 0.4 mg/kg. Arsenic was also detected in private ground water wells at concentrations as high as 26 ppb which is above the CREG for arsenic in drinking water of 0.02 ppb. Arsenic was not detected in the air samples in Area 1. Big River Zinc reported the release of 550 pounds per year of arsenic in the Toxic Release Inventory. Exposure to arsenic in the population would be by ingestion of contaminated ground water and sediments at Site M and from the sediments in CS-A through CS-F. Inhalation of dried sediments is also possible, especially in the creek sectors. The population that would be most highly exposed would be residents drinking contaminated well water and children playing in the sediments at Site M and in the creek sectors.

Long-term ingestion may also lead to a pattern of skin changes including a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. These skin changes are not a health concern by themselves, however they may later develop into skin cancer. Ingestion of arsenic has also been reported to increase the risk of liver, bladder, kidney, and lung cancers. There is sufficient evidence that inhalation of inorganic arsenic causes lung cancer in humans.

Barium

Barium was detected at concentrations above the comparison values in sediment. It was also detected in private wells, but at concentrations below comparison values. Barium was not detected during air monitoring in Area 1. In their Toxic Release Inventory data Cerro Copper reported releasing 1,727 pounds of barium per year to the air.

Site related barium exposure would occur via ingestion of barium containing ground water and sediments. Inhalation is also possible from dried sediments that may become airborne. While skin contact may occur from ground water or sediments, absorption through the skin is not likely to be significant. Little is known about the health effects of barium exposure in humans. Low level short term exposures to barium in people may cause difficulties in breathing and increased blood pressure, changes in heart rhythm, stomach irritation, changes in blood, muscle weakness, changes in nerve reflexes, swelling of the brain, and damage to liver, kidney, heart and spleen. Exposure to high levels of barium has caused paralysis and death in some individuals.

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Cadmium

Cadmium was detected in sediments samples above the chronic EMEG samples for children at Site M, and Creek Sectors A through F. The chronic EMEG for the pica child is 0.4 mg/kg and 10 mg/kg for the non-pica child. Site M and CS-A through CS-F had at least one sediment sample that was above 10 mg/kg. Cadmium was not detected in samples on off-site ground water samples. Cadmium was detected in all 43 samples taken from the surface soils at Site G at a concentration range of 2 to 46 mg/kg. The population that would have the greatest exposure would be children playing in sediments. Exposure would be primarily by ingestion of contaminated sediments. Inhalation may occur if the sediment becomes dry and is subsequently disturbed. Dermal contact would not be expected to result in significant exposure since cadmium is not readily absorbed through the skin. The TRI lists Cerro Copper as the source of 1,895 pounds of cadmium per year released to the atmosphere.

Non-carcinogenic health effects that may be associated with oral cadmium exposure are a build-up of cadmium in the kidney, which may cause kidney damage, and fragile bones. This build-up of cadmium in the kidneys is also observed in inhalation exposures, and results in the same health effects. So while ambient airborne concentrations of cadmium did not exceed the EMEG for cadmium in air, cadmium effects the body in the same way as ingested cadmium and the inhalation exposure may be added to the ingested exposure.

Manganese

Manganese was detected in all four private wells at concentrations above the intermediate EMEG for drinking water. Manganese was also detected in all sediment samples at levels above the RMEG for pica child of 10 mg/kg. The sediment samples from Creek Sectors E and F were above the RMEG for the non-pica child of 300 mg/kg. Manganese was not found in the air samples taken in Area 1. The populations exposed to manganese would be children playing in the creek sediments and residents with wells who drink well water. Exposure to both populations would be via ingestion.

The health effects associated with the ingestion of manganese may include weakness, stiff muscles, and trembling of hands. At higher levels it may cause brain injury. Manganese is believed to be necessary for maintaining health. Since manganese is a naturally occurring component of the environment, exposure occurs every day. The amount in the normal diet is between 2,500 - 5,000 mg/day. Manganese is not known to be a carcinogen via ingestion.

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Zinc

Zinc was identified in air, sediment, and ground water in Area 1. Zinc is a naturally occurring, common element in the environment. The zinc found in some ground water well samples was above the RMEG for drinking water. Zinc was also detected at levels above the RMEG for pica children of 600 mg/kg at Site M and Creek Sectors A through F. Zinc was detected in all the air samples. Zinc was not listed in the TRI data for Sauget/Cahokia/East St. Louis area. Exposure to zinc occurs throughout the population on a daily basis, however ground water, sediments, and airborne zinc in area 1 may represent additional exposures. Exposure to zinc in the Sauget area would be from site related zinc and from emissions from Big River Zinc. Additional zinc exposures would be primarily through ingestion with some exposure via inhalation.

Zinc is an essential nutrient. The health effects associated with zinc are non-carcinogenic and have been reported in individuals ingesting and inhaling zinc containing media at higher levels than those encountered in Area 1. The health effects from breathing high levels of zinc in the work place include breathing difficulties and may cause a brief sickness called metal fume fever. At very high levels breathing zinc dust or fumes may be life threatening. Ingestion of too much zinc can cause anemia and digestive problems. Excessive zinc intake may also be associated with an increased risk of heart disease and trouble in fighting disease or infection.

B. Health Outcome Data

No health outcome data are available for the Sauget area at this time. If data should become available in the future, it will be reviewed and included in this document.

C. Community Health Concerns Evaluation

The report of 9 year old girl dying of brain cancer in the 1970s is the only community health concern that was identified in the area. There are carcinogens in the creek sediments in the Judith Lane-Walnut Street area. It is not known whether the child was ever exposed to these contaminants. In addition, the latency period of cancer from environmental exposures is usually greater than 10 years. A study of cancer data in the area may indicate whether there are additional cases of brain cancer in the area.

No other community health concerns were identified in the Sauget area.

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CONCLUSIONS

The Area 1 Sauget Sites in Sauget and Cahokia, Illinois pose a public health hazard based on chronic exposure to contaminated sediments in Creek Sectors B through F. Children have been observed playing in Dead Creek and are the population that is most likely to be exposed to the sediments. Since Dead Creek is an intermittent stream, the sediments are exposed much of the time especially during the summer months. PCBs are one of the contaminants that are present in the sediments at levels above their chronic minimum risk levels for soils. Non-carcinogenic adverse health effects experienced by animals exposed to PCBs include: liver, stomach, and thyroid gland effects; anemia; and reproductive system damage. There is only limited evidence that PCBs are carcinogenic in animals. Cadmium exceeded its chronic minimum risk level in all creek sectors. Adverse health effects associated with cadmium exposure include kidney damage and fragile bones. Benzo(a)pyrene and arsenic exceeded their cancer risk evaluation guidelines in Dead Creek sediments. Other carcinogenic PAHs were found in Dead Creek sediments including: benzo(a)anthracene, benzo(b)fluoranthene, chrysene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(cd)pyrene. Arsenic exceeded its cancer risk evaluation guideline in ground water at a private well.

Airborne exposures to Site G contaminants including PCBs, are occurring by volatilization and fugitive dust generation. The population that would be exposed to airborne Site G contaminants are nearby residents and employees in area industries and businesses.

Exposure to site related contaminants would likely have been higher in the past. During site operations, especially at Sites G, H, I, and CS-A, exposures to area residents and employees would have been much higher than they are today. Past exposures would have included the persons involved with the site operations. The employees on site during active site operations potentially could have been exposed to very high levels of site related contaminants. The potential for high exposures are due to more concentrated wastes and working in close proximity to the wastes.

Remediation of the site may expose residents and workers to on-site contaminants. This exposure has the potential to be much higher than any of the current site related exposures. Workers should have adequate protection from inhalation and dermal exposure to on-site contaminants. Residents may be exposed to on-site contaminants by volatilization and fugitive dust generation during remediation.

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RECOMMENDATIONS

Cease/Reduce Exposure Recommendations

1. Contaminants that have been left exposed on the surface soil should be removed or contained in such a way that they are not released to the air or allowed to move by surface runoff.
2. Precautions should be taken during site remediation to protect both the workers and residents from exposure to site contaminants.
3. Contaminants in Creek Sectors C, D, E, and F should be removed or access to these areas controlled so that children are not allowed to play in them.
4. The use of private wells or industrial wells that are contaminated or are near contaminated ground water plumes should be discontinued and the wells filled. In addition, no new wells should be installed.
5. Repair any holes in the fences. Take additional steps to prevent access to sites, including using barbed wire at the top of fences.

Site Characterization Recommendations

1. Air monitoring at exposure points may be necessary to determine airborne exposure to contaminants. Exposure points would include nearby residences and area businesses and industries. Air monitoring would be important in determining airborne contaminant concentrations during remediation.
2. Ground water contaminants should be monitored regularly to determine movement in off-site areas. Remediation should remove or at least prevent further migration of contaminants off-site.
3. The areas surrounding Creek Sectors C and D should be thoroughly investigated so that recontamination by ground water or surface runoff does not occur.
4. Residences (if any) that are suspected to have indoor air contamination due to site related compounds should have their air tested.

Sauget Sites Area 1 Public Health Assessment - First Draft

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CERTIFICATION

This public health assessment was prepared by the Illinois Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment, and concurs with its findings.

Director, DHAC, ATSDR

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APPENDICES

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APPENDIX A. FIGURES



Figure 1. Area 1 Sites Location Map

Source: E & E, 1977.

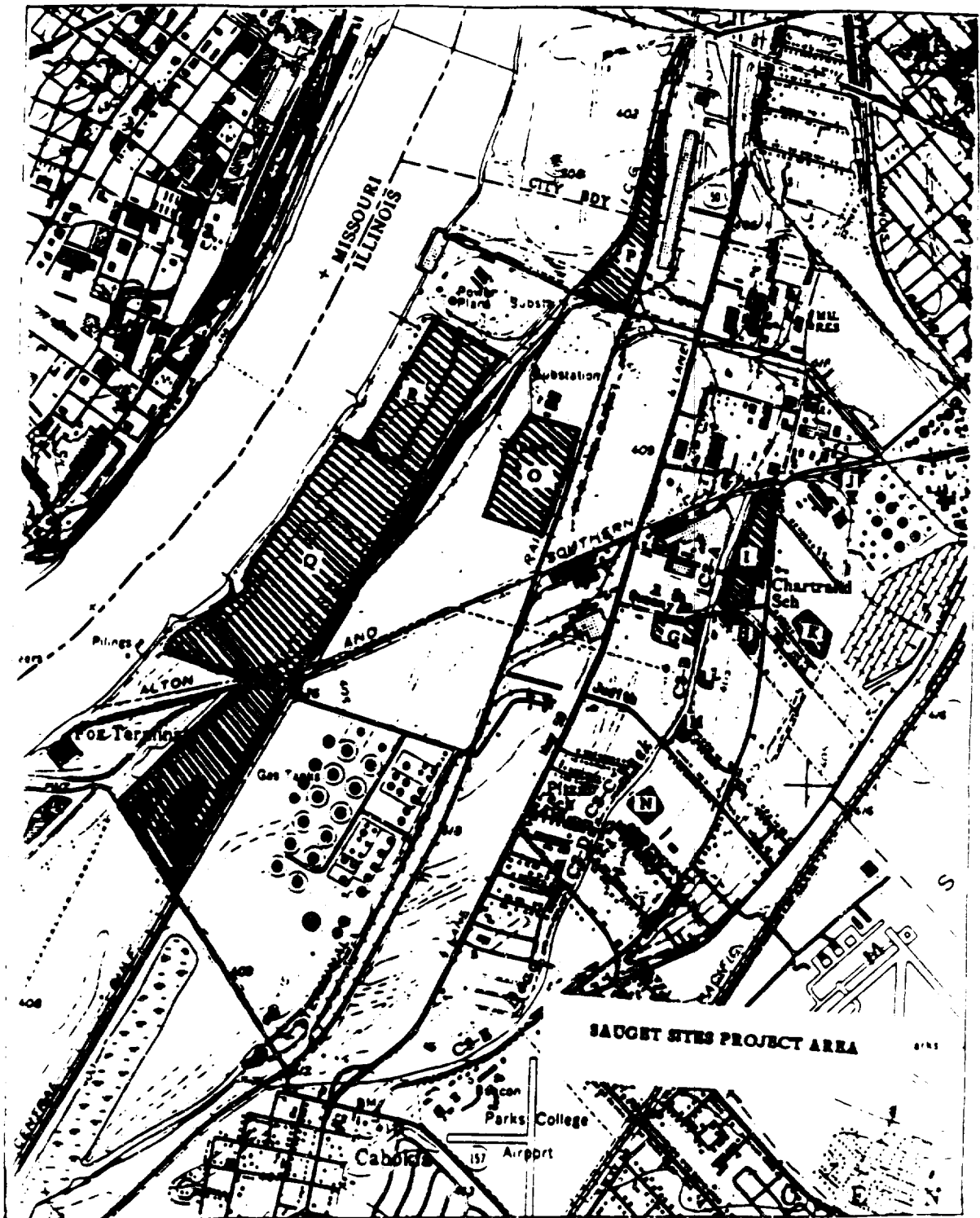


Figure 2 - Site Location Map

Source: IEPA, 1987.

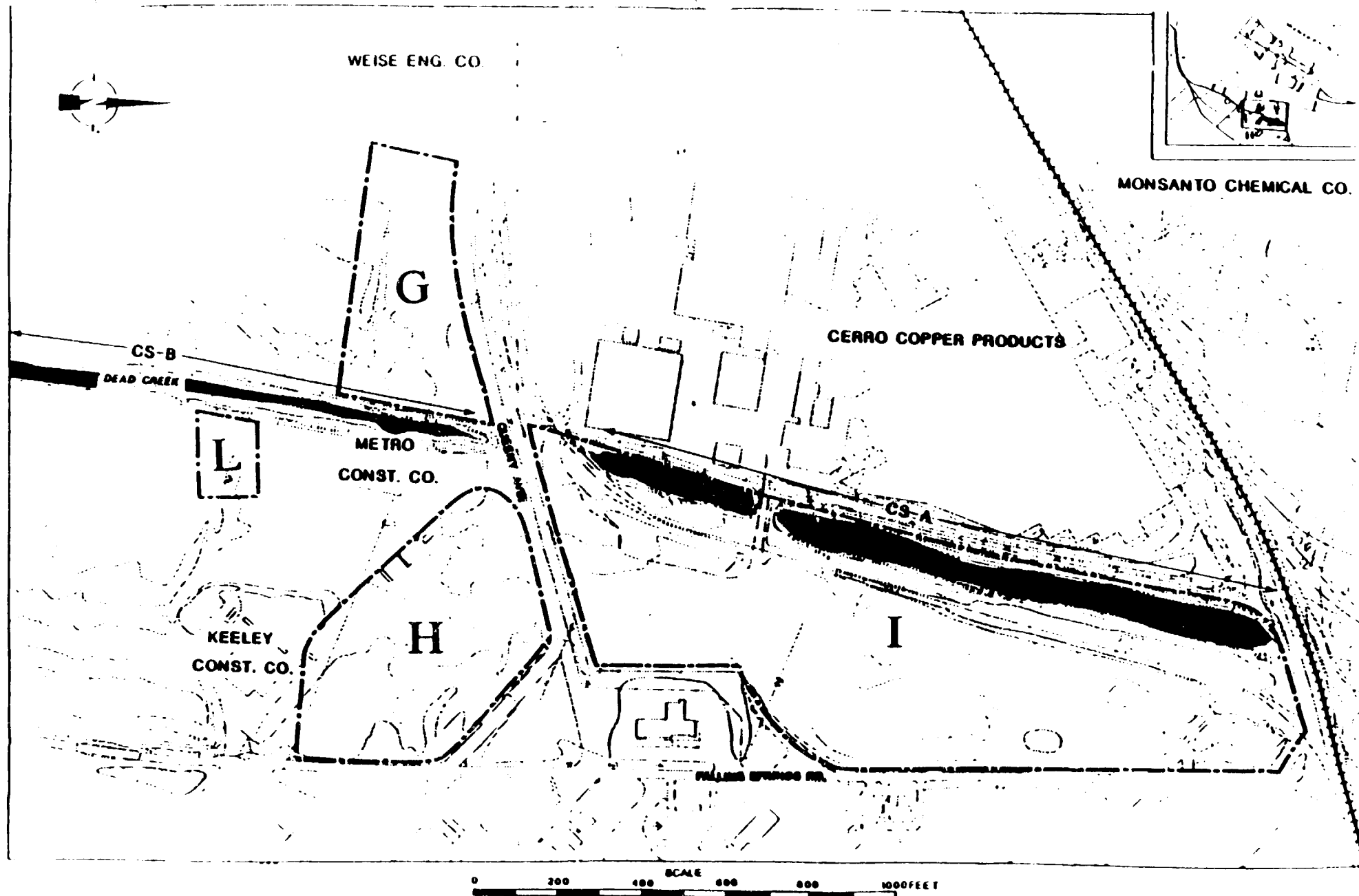
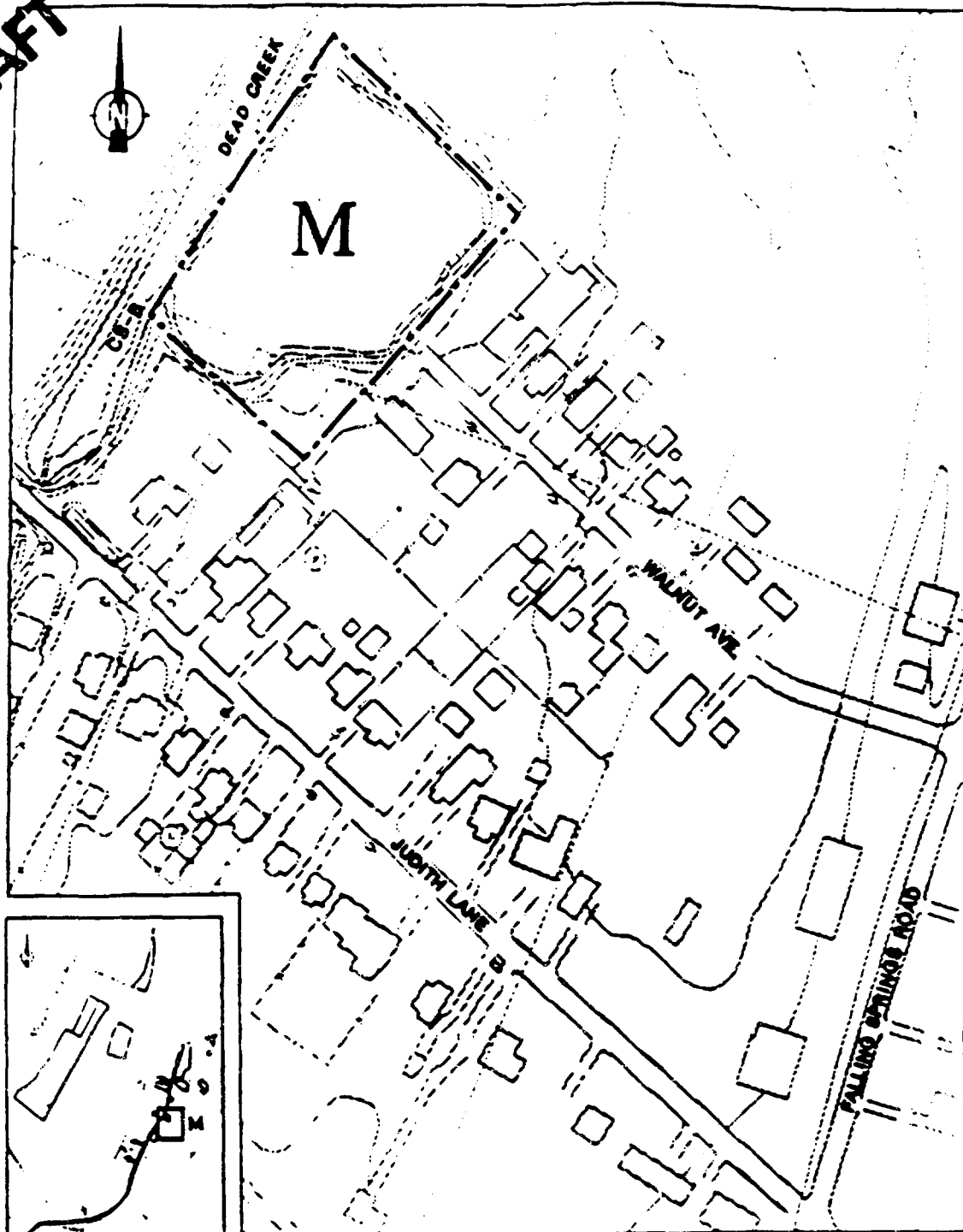


Figure 3. Site Features Map for Sites G, H, I, and CS-A and CS-B

Source: E & E, 1988.

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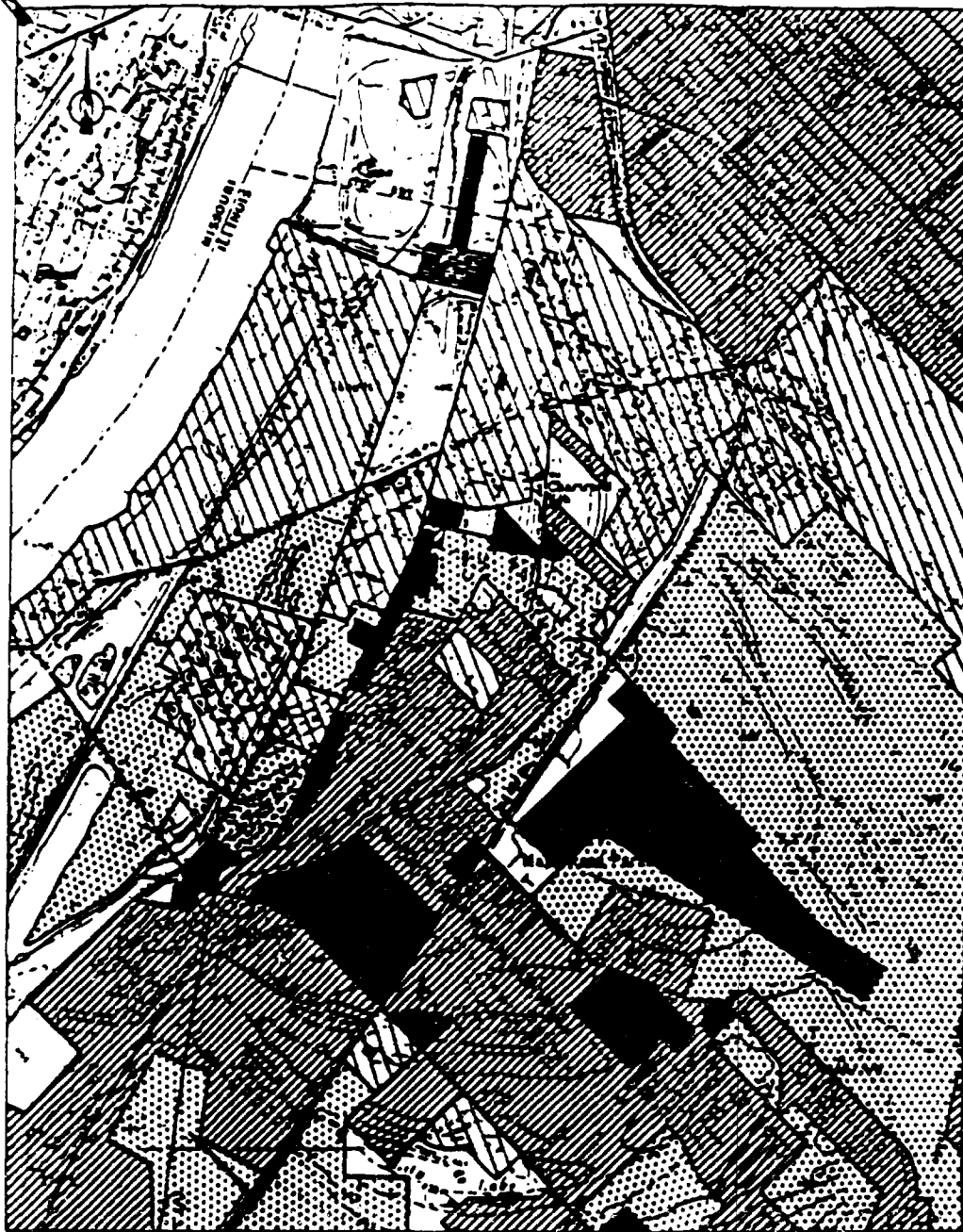
SOURCE: Ecology and Environment, Inc., 1988.

SCALE
0 100 200 300 400 500 FEET

Figure 4. Site Features Map for Site M

Source: E & E, 1988.

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SOURCE: Ecology and Environment, Inc., 1988.

0 1 2 3 4 5 MILES

LEGEND

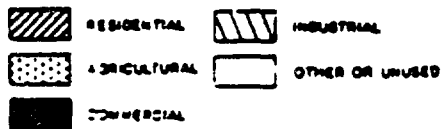


Figure 6. Land Use Map of the Sauget/Cahokia Area

Source: E & E, 1988.

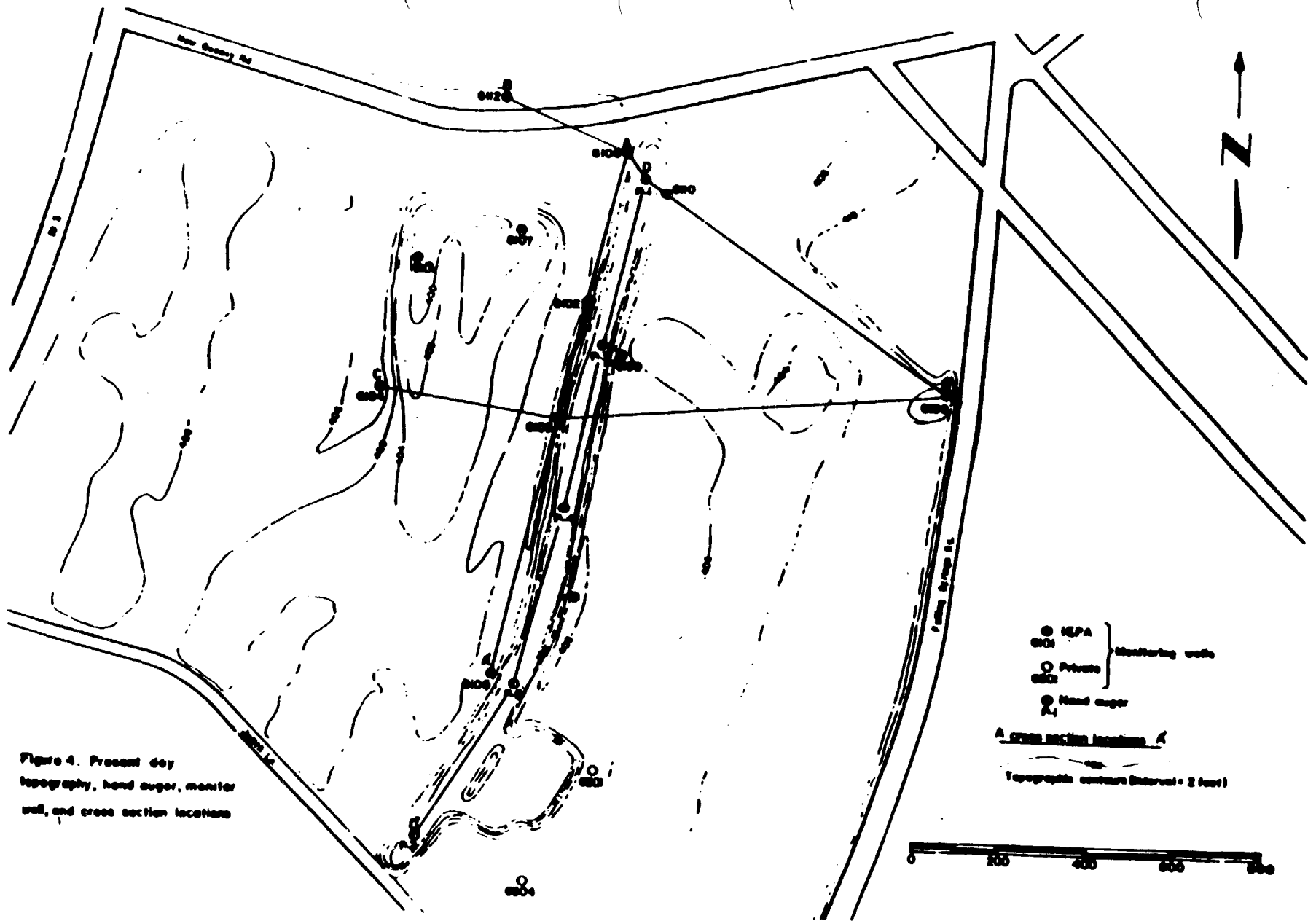


Figure 7. Locations for 1980 IEPA Hydrogeologic Investigation in the Vicinity of Site G

Source: IEPA, 1981.

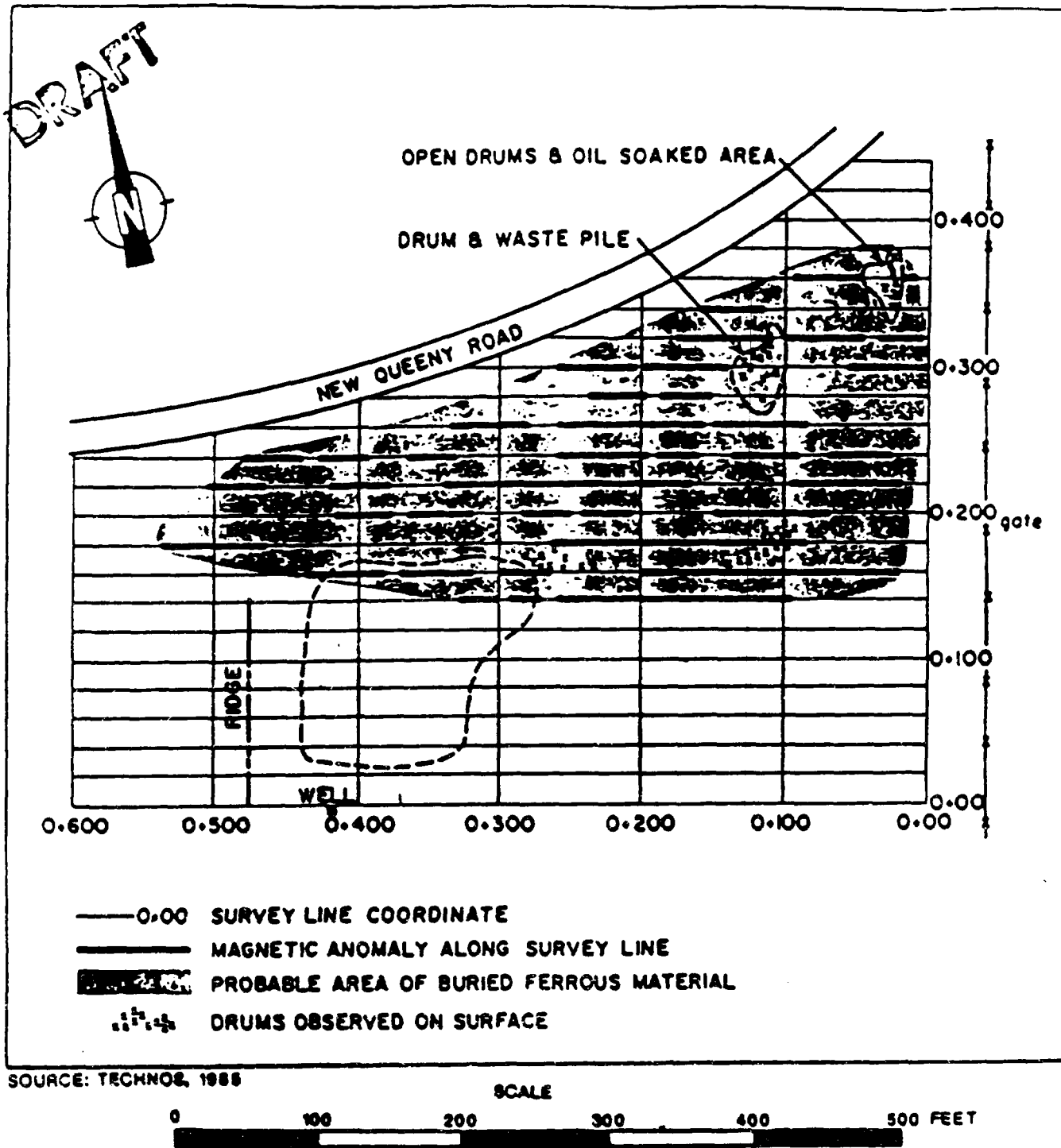


Figure 8. Magnetometry Survey Results at Site G

Source: E & E, 1988.

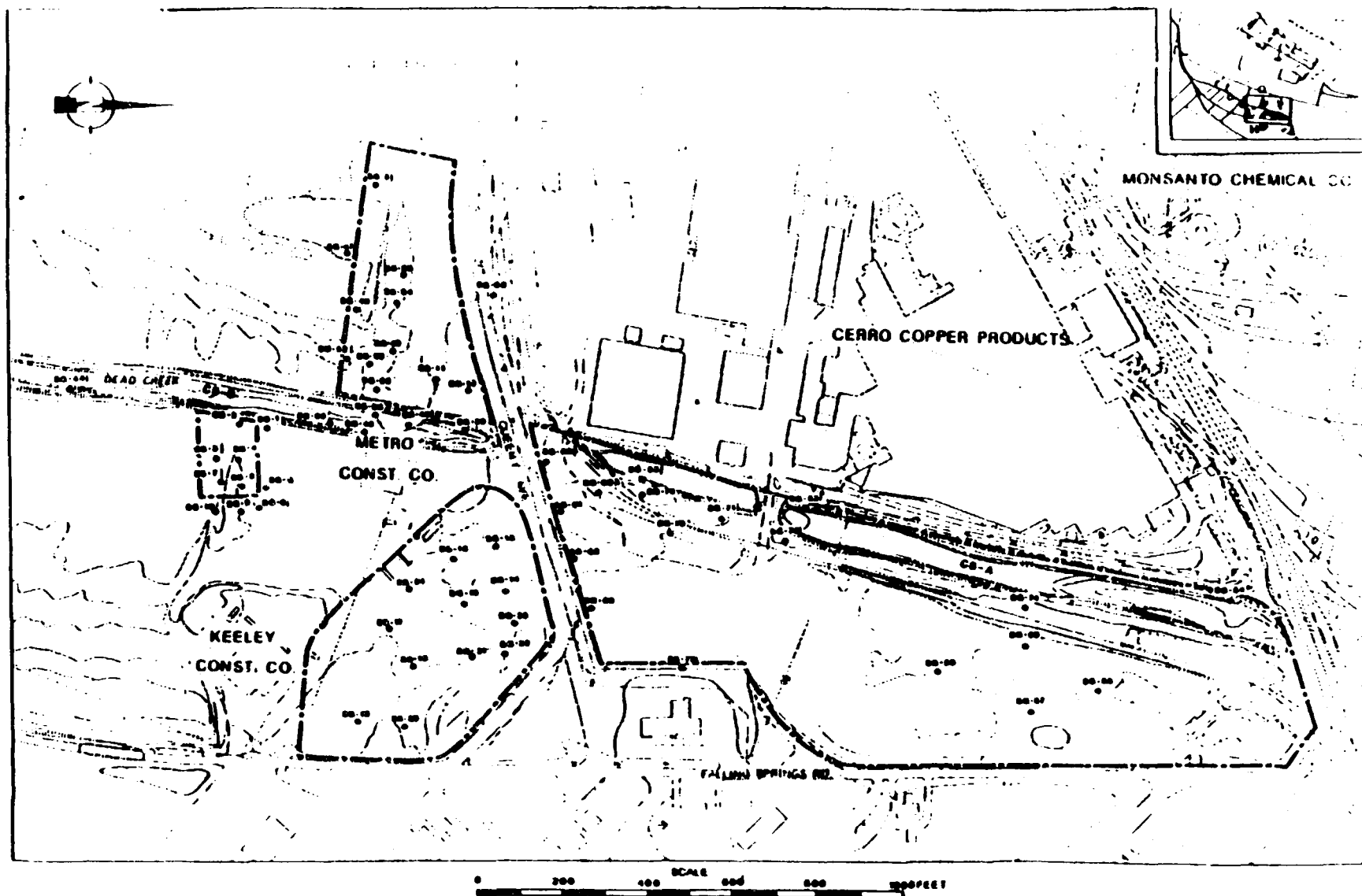


Figure 9. Soil Gas Sampling Locations at Sites G, H, I, and CS-A and B

Source: E & F, 1988.

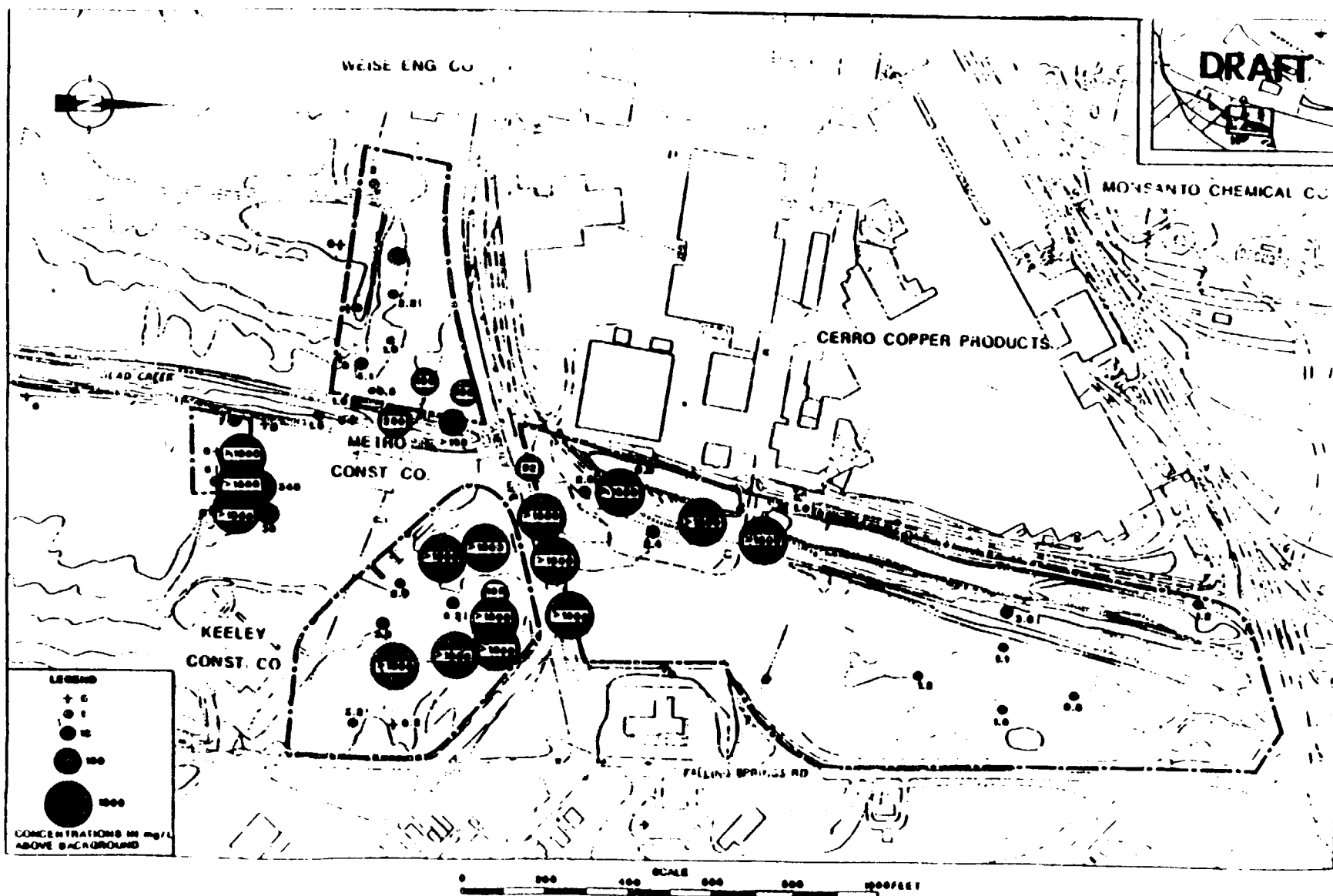


Figure 10. Soil Gas Analysis Results for Sites G, H, I, and L

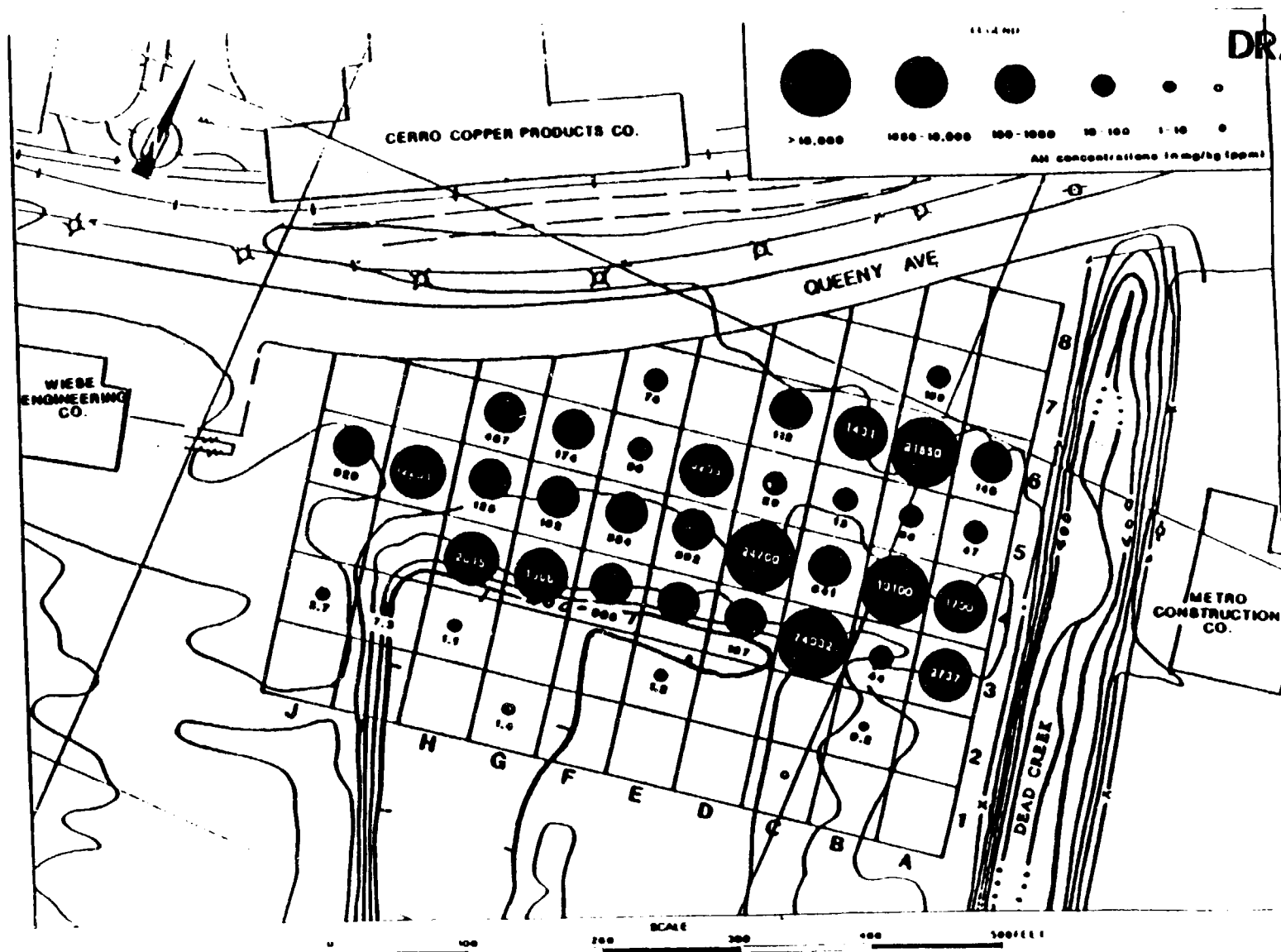


Figure 11. Total Organic Concentrations in Surficial Soil at Site G

Source: E. A. E., 1998.

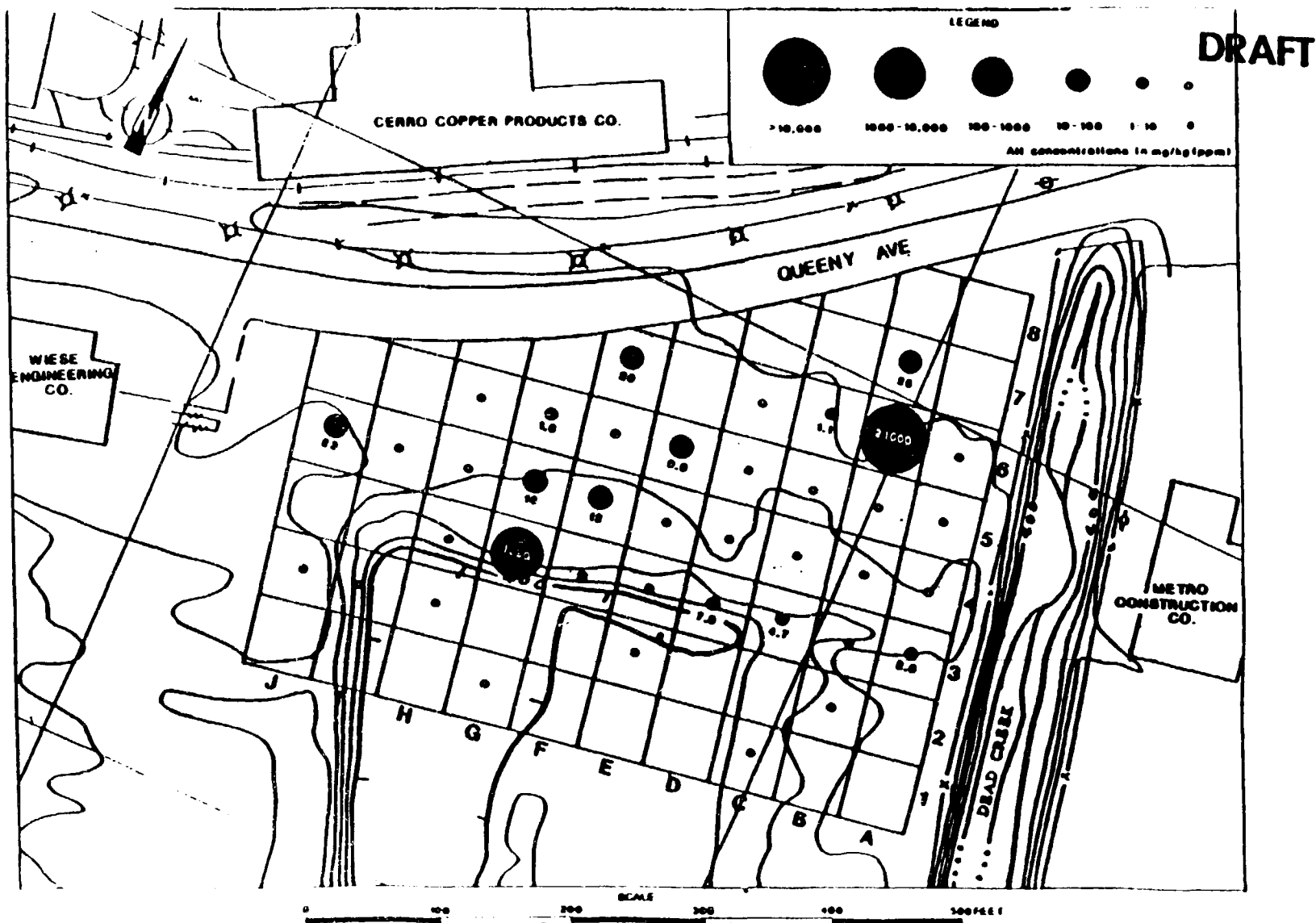


Figure 12. Pentachlorophenol Concentration in Surface Soils at Site G

(SOURCE: E & E, 1988.)



Figure 14. Concentrations of Select Organic Contaminants in Surface Soils at Site G

Source: E & E, 1988.

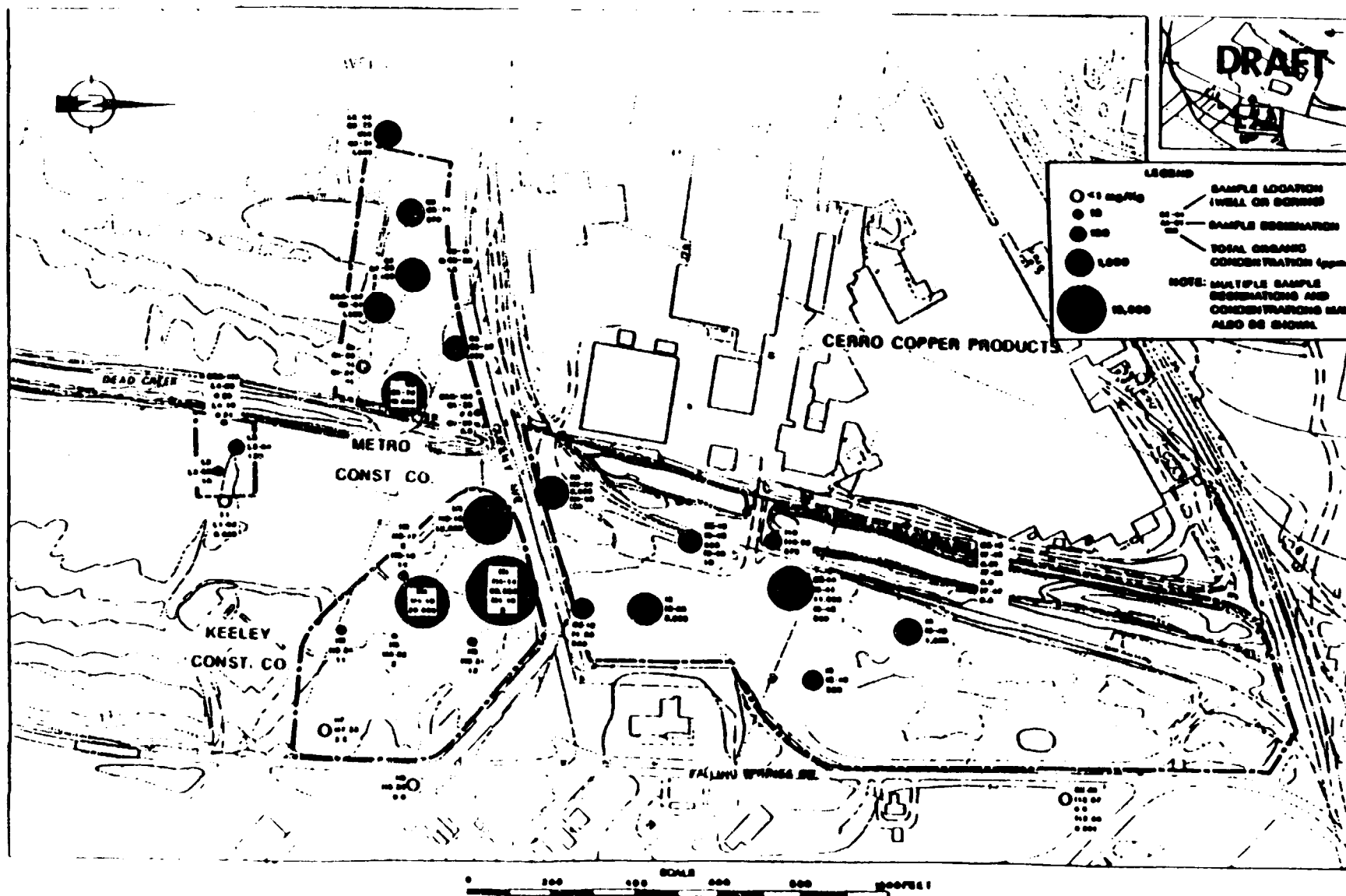


Figure 15. Total Organic Concentration in Subsurface Soils at Sites G, H, I, and L

Source: E & E, 1988.

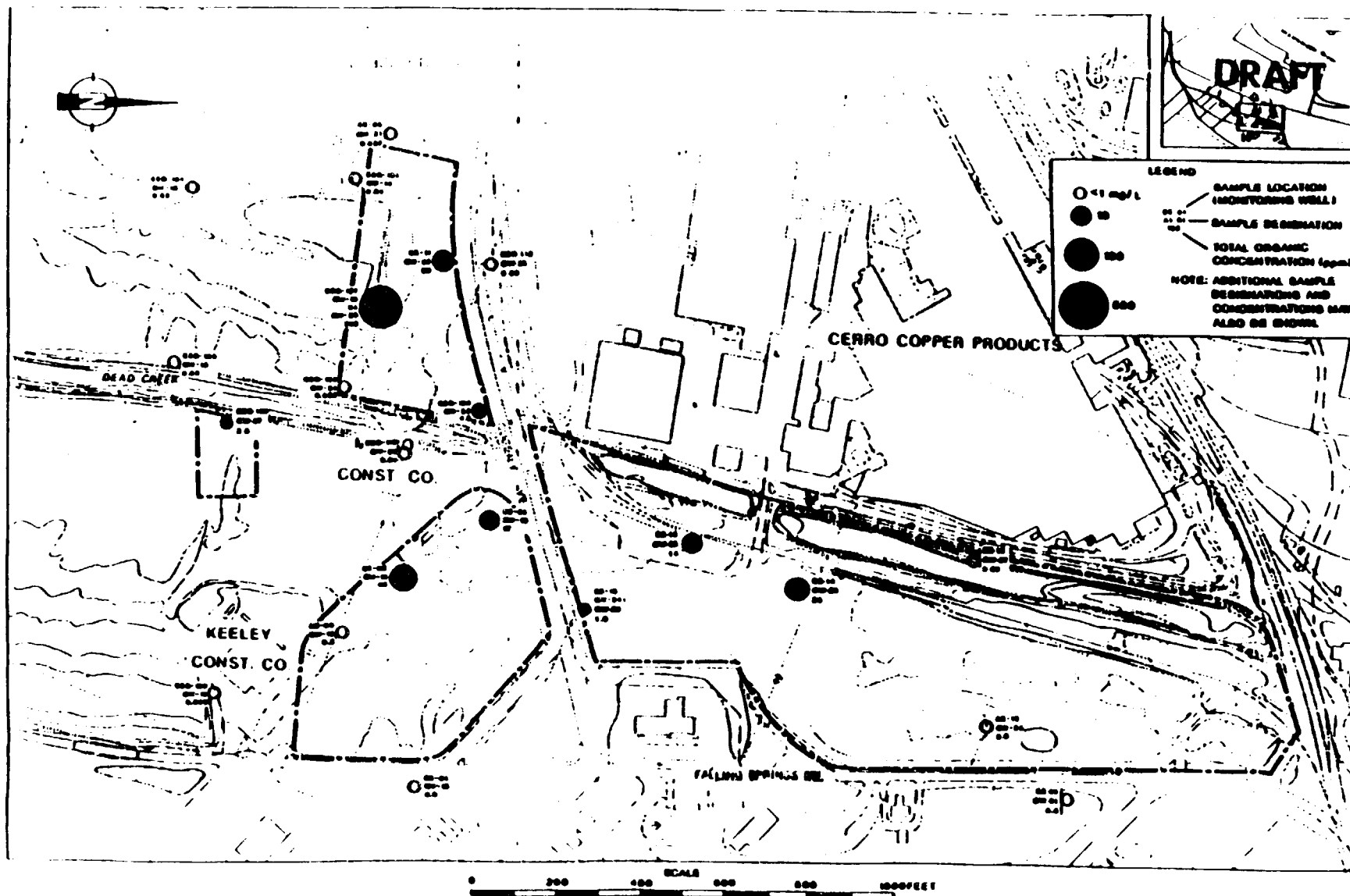


Figure 17. Total Organic Concentrations in Ground Water at Area 1

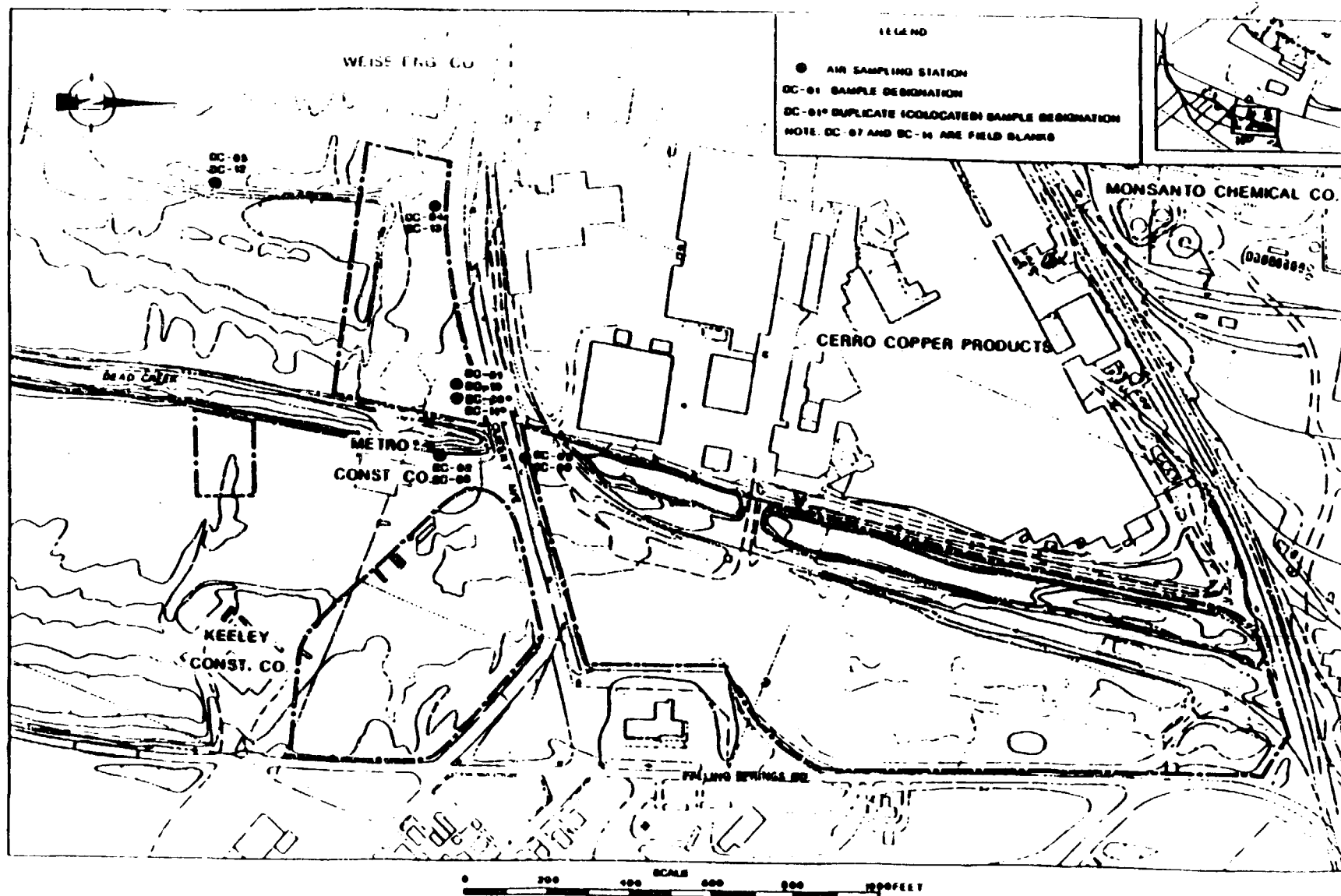


Figure 18. Air Sampling Locations at Site G and Creek Sector B

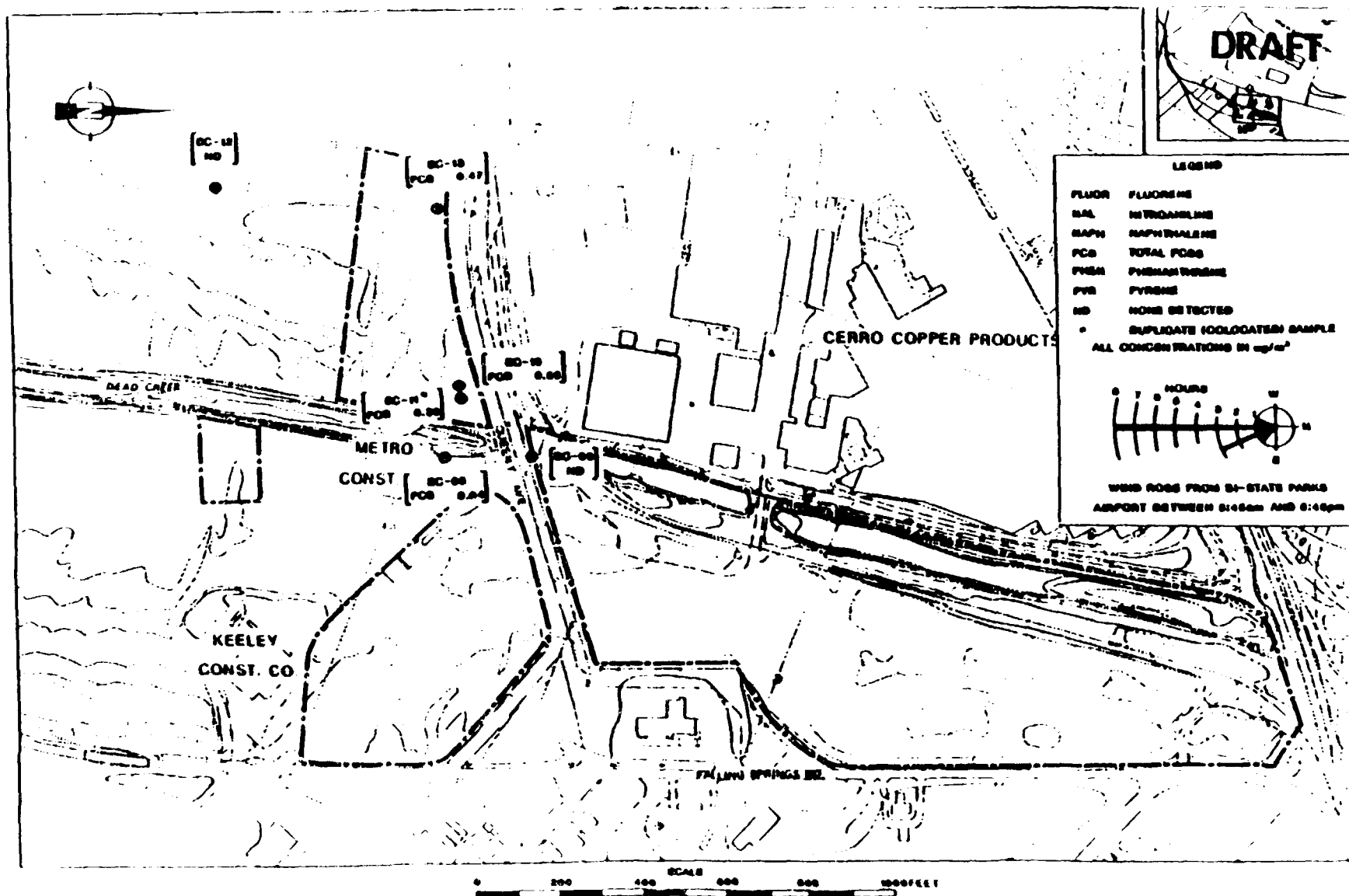


Figure 20. Results of Select Organic Compounds in Air Samples taken on July 17, 1987

(Source: E & E, 1988.)

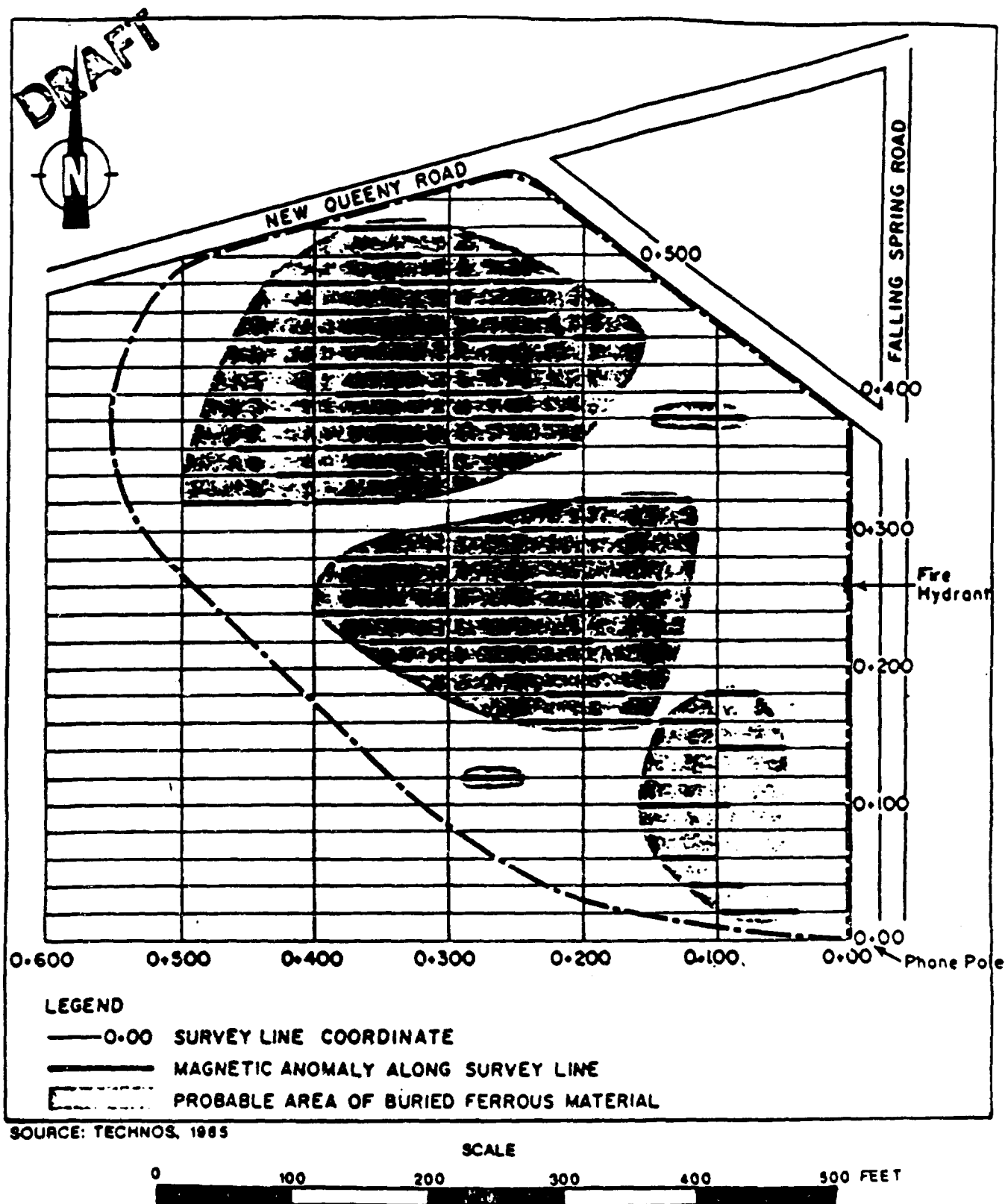


Figure 21. Magnetometry Survey of Sites H

Source: E & E, 1985

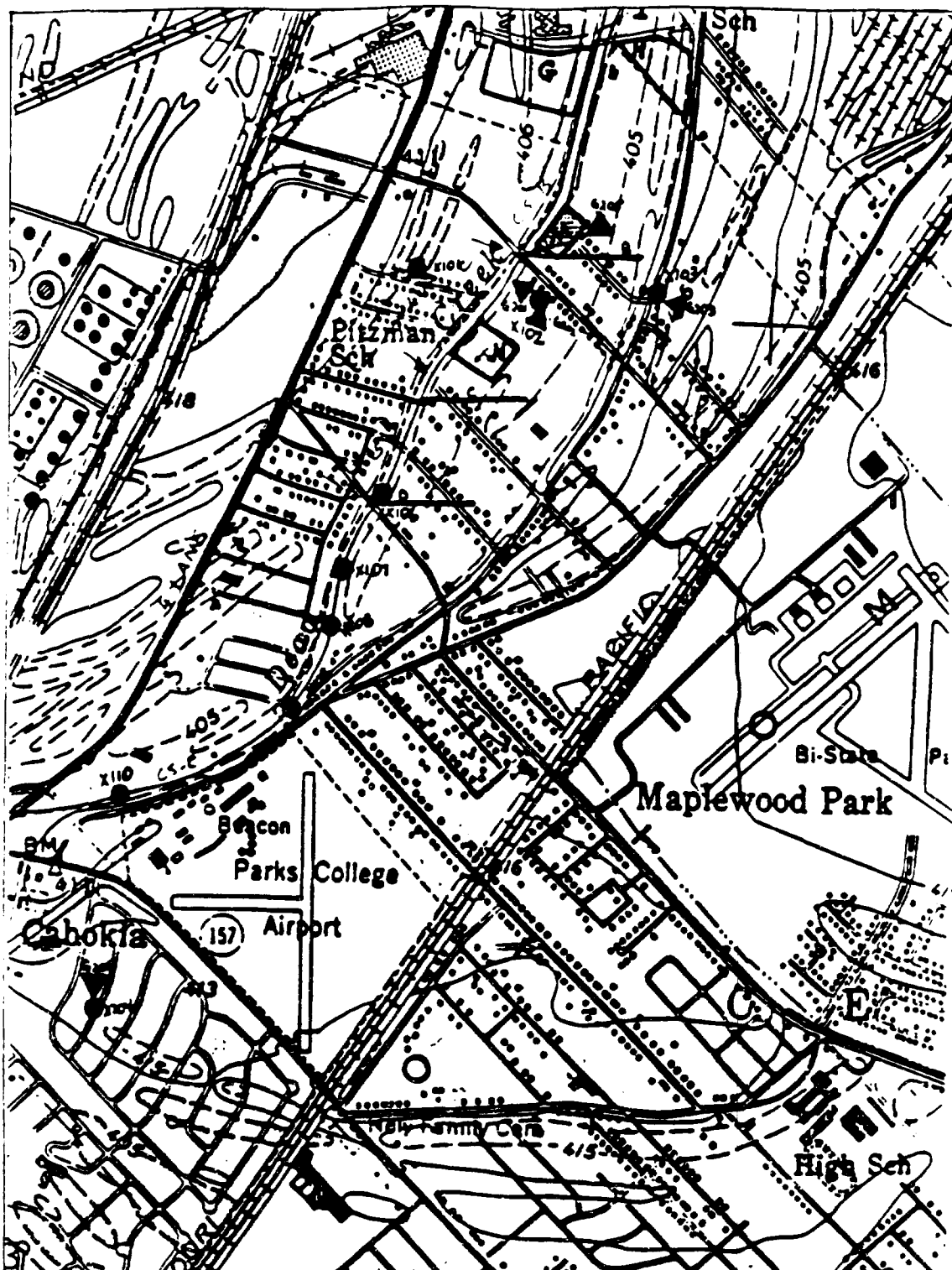


Figure 24. Sediment, Ground Water, and Soil Sample Locations for Samples taken by IEPA in 1991 in Off-site and Creek Sectors D-E.

Source: IEPA, 1991.

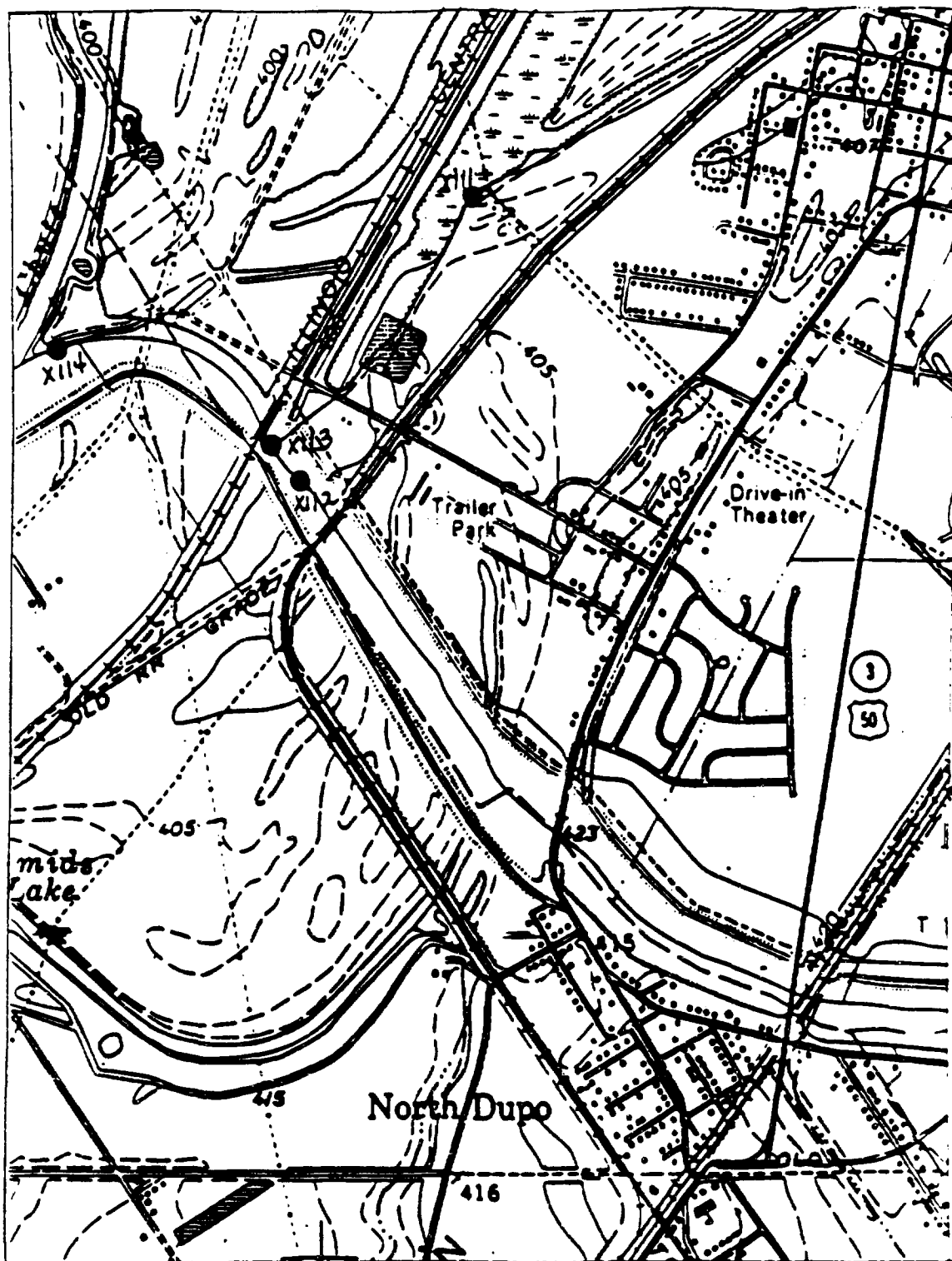
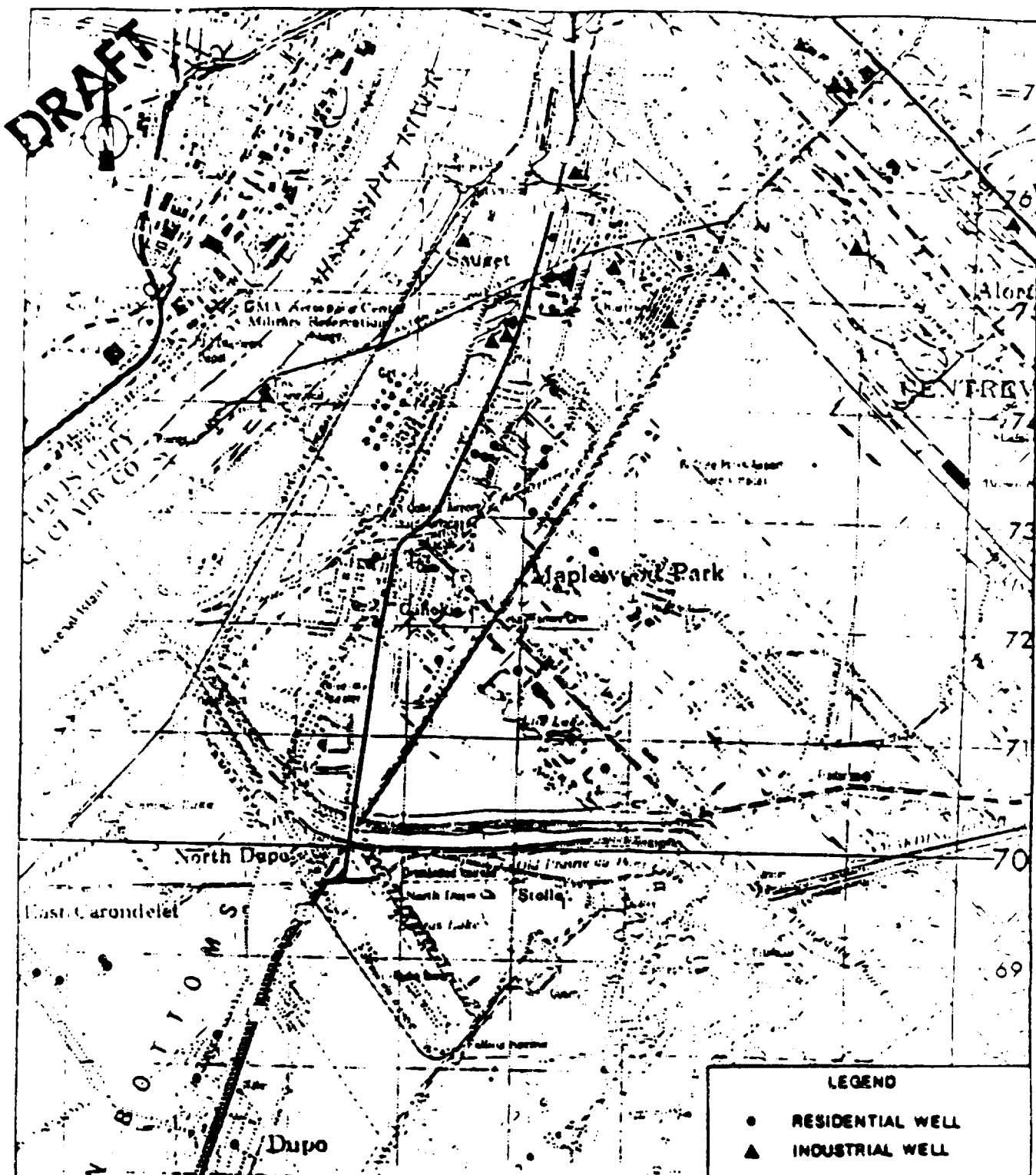


Figure 25. Sediment, Ground Water, and Soil Sample Locations for Samples taken by IEPA in 1991 in Off-site and Creek Sectors D-E.

Source: IEPA, 1991.



SOURCE: Ecology and Environment, Inc., 1988.

Figure 26. Residential and Industrial Well Locations in the Study Area

Source: E & E, Inc.

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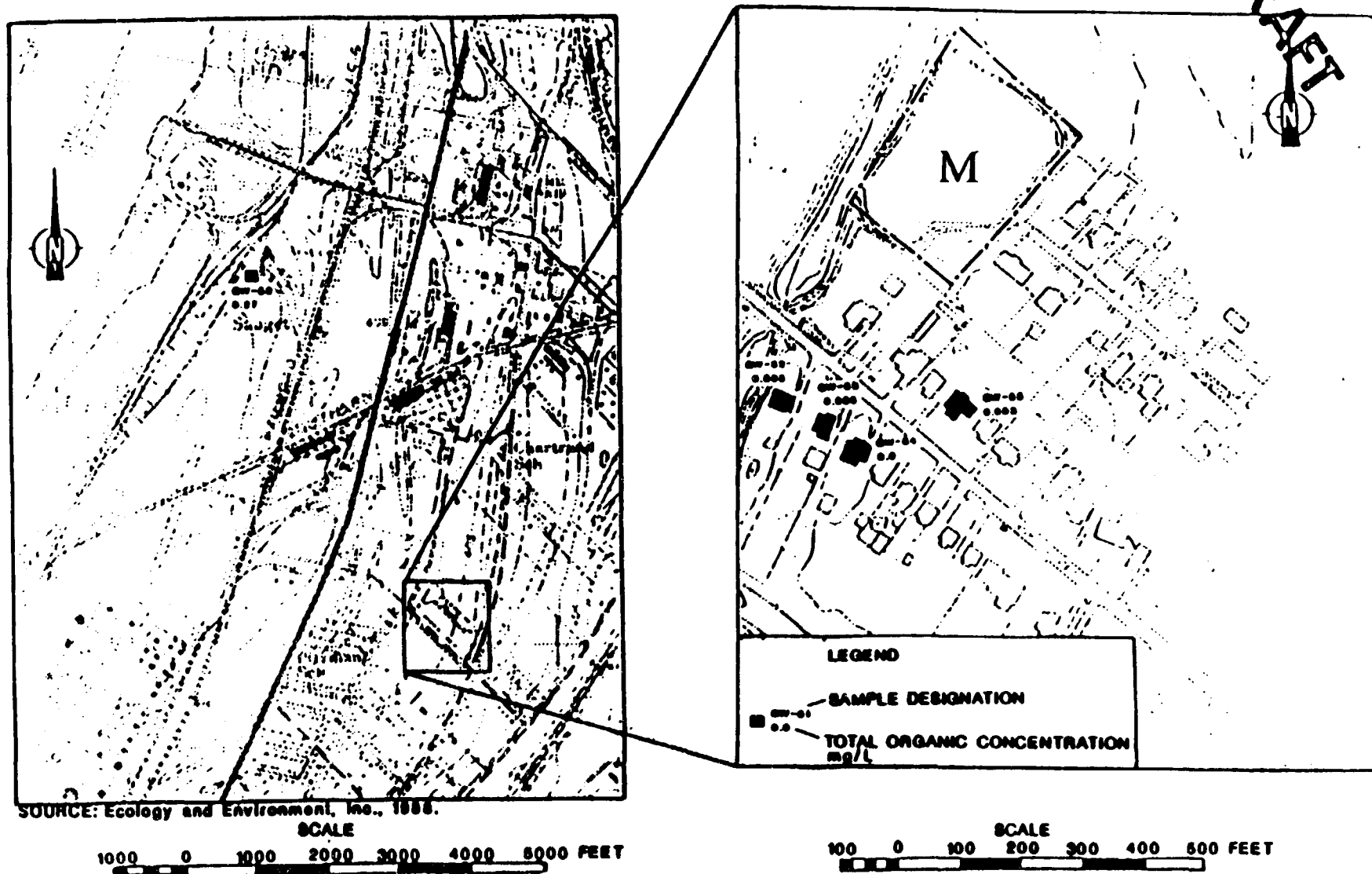


Figure 27. Total Organic Concentrations in Residential Wells in Area

SOURCE: E & E, 1988.

APPENDIX B. TABLES

Table 1. Toxic Release Inventory for Zip Codes 62202 and 62206 in Pounds per Year

Compound	Company			
	Monsanto	Cerro Copper	Big River Zinc	Ethyl Petroleum Additives
VOLATILES				
Dichloromethane	NL	12,130	NL	NL
1,4-Dioxane	NL	13,150	NL	NL
Ammonia	111,300	14,620	NL	NL
Methyl Isobutyl Ketone	30,000	NL	NL	NL
Methyl Ethyl Ketone	1,800	NL	NL	NL
Ethylbenzene	150,000	NL	NL	NL
1,1,1-Trichloroethane	NL	506,800	NL	NL
Trichloroethane	NL	34,380	NL	NL
Benzene	28,800	NL	2,406	NL
Chlorobenzene	50,000	NL	NL	NL
Styrene	NL	NL	NL	262
SEMIVOLATILES				
Aniline	100,700	NL	NL	NL
4-Nitrophenol	7,300	NL	NL	NL
2-Nitrophenol	0	NL	NL	NL
1,3-Dichlorobenzene	220	NL	NL	NL
1,4-Dichlorobenzene	15,800	NL	NL	NL
1,2-Dichlorobenzene	5,500	NL	NL	NL
Xylenes	740,000	NL	NL	3,350
Naphthalene	NL	NL	NL	4,600
INORGANICS				
Arsenic	NL	NL	500	NL
Barium	NL	1,727	NL	NL
Cadmium	NL	1,895	NL	NL
Chromium, trivalent	NL	1,500	NL	NL
Cobalt	NL	NL	NL	NL
Copper	NL	37,300	500	NL
Lead	NL	1,300	3,634	NL
Manganese	NL	NL	500	NL
Nickel	360	NL	NL	NL

Source: TRI - 1987, 1988, 1989, 1990.

Table 2. - Contaminants in Surface Soils at Site G

Compound	Concentration Range in ppm	Frequency of Detection (n = 43)	Soil in ppm*	Source
VOLATILES				
2-Butanone	0-0.18	25	NL	NL
Trichloroethene	0-0.019	2	60	CREG
Benzene	0-0.08	3	20	CREG
4-Methyl-2-pentanone	0-2.0	22	NL	NL
2-Hexanone	0-0.089	9	NL	NL
Toluene	0-1.4	9	400/10000	RMEG
Chlorobenzene	0-0.04	2	800/20000	EMEG
SEMIVOLATILES				
Phenol	0-0.078	1	1000/30000	RMEG
1,4-Dichlorobenzene	0-22000	4	NONE	NONE
1,2-Dichlorobenzene	0-0.089	1	200/5000	RMEG
2,4-Dichlorophenol	0-6.2	2	6/200	RMEG
1,2,4-Trichlorobenzene	0-35	8	20/500	RMEG
Naphthalene	0-120	11	NONE	NONE
2-Methylnaphthalene	0-1.0	3	NONE	NONE
2,4,6-Trichlorophenol	0-1.5 J	1	60	CREG
2-Nitroaniline	0-220	4	NONE	NONE
Acenaphthalene	0-1.8	6	100/3000	RMEG
4-Nitrophenol	0-1000	1	NONE	NONE
Dibenzofuran	0-0.92	3	NL	NL
Fluorene	0-1.5	1	80/2000	RMEG
3,3'-Dichlorobenzidine	0-85	12	NONE	NONE
Hexachlorobenzene	0-10 J	1	2/40	EMEG
Pentachlorophenol	0-21000	14	6	CREG
Phenanthrene	0-40 J	10	NL	NL
Di-n-butyl phthalate	0-3.8 J	9	NONE	NONE
Fluoranthene	0-45	11	80/2000	RMEG
Benzo(a)Anthracene	0-27	8	NL	NL
bis(2-ethylhexyl) phthalate	0-6.0	12	NONE	NONE
Chrysene	0-39 J	11	NONE	NONE
Di-n-octyl phthalate	0-14 B	7	NONE	NONE
Benzo(b)Fluoranthene	0-48	9	NONE	NONE
Benzo(k)Fluoranthene	0-10 J	4	NONE	NONE
Benzo(a)Pyrene	0-22 J	13	0.1	CREG

Compound	Concentration Range in ppm	Frequency of Detection (n = 43)	Soil in ppm*	Source
Indeno(1,2,3-cd)Pyrene	0-5.2	5	NONE	NONE
Benzo(g,h,i)Perylene	0-1.5 J	5	NONE	NONE
Dibenzo(a,h)Anthracene	0-54	6	NONE	NONE
PESTICIDES/PCBs				
4,4'-DDE	0-0.29	5	2	CREG
Aroclor-1248	0-3600	12	0.01/0.3	EMEG
Aroclor-1254	0-29000	6	0.01/0.3	EMEG
Aroclor-1260	0-21000	36	0.01/0.3	EMEG
INORGANICS				
Antimony	0-21	5	0.8/20	RMEG
Arsenic	4.1-84	43	0.4	CREG
Barium	138-1690000	43	100/4000	RMEG
Beryllium	0-1.4	1	0.2	CREG
Cadmium	2-46	43	0.4/10	EMEG
Chromium, trivalent	11-147	43	2000/50000 10/30	RMEG RMEG
Cobalt	3.3-89	40	NONE	NONE
Copper	162-5000	43	NONE	NONE
Lead	68-18400	43	NONE	NONE
Manganese	43-10800	43	10/300	RMEG
Mercury	0-26	38	NONE	NONE
Nickel	0-382	42	NONE	NONE
Selenium	0-4.1	5	6/200	EMEG
Silver	0-33	20	10/300	RMEG
Thallium	0-21	1	NONE	NONE
Vanadium	11-19400	43	NONE	NONE
Zinc	3.9-67800	43	600/20000	RMEG
Cyanide	0-22	17	40/1000	RMEG

* - Soil values are for pica child/child.

B = Compound found in blank sample.

J = Estimated Value

Table 3. Subsurface Soil Analyses in Area 1

Compound	Site G Levels		Site H Levels		Site I Levels		Site L Levels		Area 1 Levels		Comparison Values	
	Range	f	Range	f	Range	f	Range	f	Range	f	Soil' (ppm)	Source
VOLATILES												
trans-1,2-Dichloroethene	0-0.7 J	1/12	ND	0/11	0-0.003	1/16	ND	0/5	0-0.7 J	2/44	40/1000	RMEG
Chloroform	0-11.63	1/12	0-0.19	2/11	ND	0/16	0-20.3	3/5	0-20.3	6/44	20/500	C EMEG
1,2-Dichloroethane	0-0.435 J	1/12	0-0.012 J	1/11	ND	0/16	ND	0/5	0-0.435 J	2/44	8	C REG
2-Butanone	0-15.2	11/12	0-27.2	5/11	0-16.8 B	15/16	0-10.0 B	3/5	0-27.2	24/44	NL	NL
1,1,1-Trichloroethane	ND	0/12	ND	0/11	0-1.7	2/16	ND	0/5	0-1.7	2/44	NONE	NONE
Trichloroethene	0-3.85	4/12	0-0.001 J	1/11	0-3.8	2/16	ND	0/5	0-3.85	7/44	60	C REG
Benzene	0-45.3	7/12	0-61.3	7/11	0-24.1	10/16	0-4.2	4/5	0-61.3	26/44	20	C REG
4 Methyl-2 pentanone	0-6.0	4/12	0-7.85	4/11	0-4.2	2/16	0-0.17	4/5	0-7.85	14/44	NL	NL
Toluene	0-117.6	6/12	0-76.5	5/11	0-77.9	11/16	0-26.6	4/5	0-117.6	26/44	400/10000	RMEG
Chlorobenzene	0-538.5 E	10/12	0-45.2 E	6/11	0-126.9	6/12	ND	0/5	0-538.5	28/44	800/20000	I EMEG
SEMVOLATILES												
Phenol	0-177.8	1/12	0-0.42 J	1/11	0-27 J	2/16	0-1.5	2/5	0-177.8	6/44	1000/30000	RMEG
2-Chlorophenol	0-8.8 J	1/12	ND	0/11	ND	0/16	0-2.2	1/5	0-8.8 J	2/44	10/300	RMEG
1,3-Dichlorobenzene	ND	0/12	0-242 J	3/11	0-70	2/16	ND	0/5	0-242 J	5/44	NONE	NONE
1,4-Dichlorobenzene	0-3.8	3/12	0-30645 E	4/11	0-1873	8/16	0-0.22 J	1/5	0-30645 E	26/44	NONE	NONE
1,2-Dichlorobenzene	ND	0/12	0-19355	3/11	0-324	6/16	ND	0/5	0-19355	9/44	200/5000	RMEG
2-Methylphenol	0-3.6 J	1/12	ND	0/11	ND	0/16	ND	0/5	0-3.6 J	1/44	100/3000	RMEG
4-Methylphenol	ND	0/12	0-0.172 J	1/11	ND	0/16	0-1.1 J	2/5	0-1.1 J	3/44	NONE	NONE
2,4-Dimethylphenol	ND	0/12	0-0.092 J	1/11	ND	0/16	ND	0/5	0-0.092	1/44	NONE	NONE
2,4-Dichlorophenol	0-141.4	3/12	0-724	5/11	0-9.0	1/16	ND	0/5	0-724	9/44	6/200	RMEG

Compound	Site G Levels		Site H Levels		Site I Levels		Site L Levels		Area 1 Levels		Comparison Values	
	Range	f	Range	f	Range	f	Range	f	Range	f	Soil (ppm)	Source
1,2,4-Trichlorobenzene	0-120	4/12	0-7580	8/11	0-8255	8/16	ND	0/5	0-8255	18/44	20/500	RMEG
Naphthalene	0-542.9	7/12	0-2265	4/11	0-515	7/16	0-0.53	2/5	0-2265	20/44	NONE	NONE
4-Chloroaniline	0-230.8	3/12	ND	0/11	0-43.2	1/16	ND	0/5	0-230.8	4/44	8/2000	RMEG
2-Methylnaphthalene	0-37.1	4/12	0-347	3/11	0-168	7/16	0-1.0 J	2/5	0-347	16/44	NONE	NONE
2,4,6-Trichlorophenol	0-49.5	1/12	0-613	2/11	ND	0/16	ND	0/5	0-613	3/44	60	CREG
2,4-Dinitrophenol	0-14 J	1/12	ND	0/11	ND	0/16	ND	0/5	0-14 J	1/44	4/100	RMEG
Dibenzofuran	0-33.8	2/12	0-604	4/11	0-5.5 J	1/16	ND	0/5	0-604	7/44	NL	NL
Fluorene	0-11.3	2/12	0-483	3/11	0-36.4	3/16	ND	0/5	0-483	7/44	60/2000	RMEG
4-Nitroaniline	ND	0/12	0-1834 E	1/11	ND	0/16	ND	0/5	0-1834 E	1/44	NONE	NONE
N-Nitrosodiphenylamine	0-178	1/12	0-6.7 J	1/11	0-100	2/16	0-0.31 J	1/5	0-178	4/44	NONE	NONE
Hexachlorobenzene	0-40.6	2/12	0-0.71	1/11	0-1270	7/16	ND	0/5	0-1270	10/44	2/40	C EMEG
Pentachlorophenol	0-4770	5/12	ND	0/11	0-192	1/16	0-58.2	2/5	0-4770	18/44	6	CREG
Phenanthrene	0-51.5	4/12	0-2114	6/11	0-102	5/16	0-1.8 J	2/5	0-2114	17/44	NL	NL
Di-n-butyl phthalate	0-17.6	6/12	0-25.7	9/11	0-203	9/16	0-2.8	3/5	0-203	27/44	NONE	NONE
Fluoranthene	0-6.6	1/12	0-1330	4/11	0-203	3/16	0-0.45	1/5	0-1330	9/44	60/2000	RMEG
Pyrene	0-19.0	2/12	0-664	3/11	0-49.3	4/16	0-0.28 J	1/5	0-664	10/44	60/2000	RMEG
Benz(a)Anthracene	ND	0/12	0-378	3/11	0-6.7	2/16	0-0.91 J	1/5	0-378	6/44	NL	NL
bis(2-ethylhexyl) phthalate	ND	0/12	0-0.614	4/11	0-130	7/16	0-1.22	3/5	0-130	14/44	NONE	NONE
Chrysene	0-22.9	1/12	0-332	3/11	0-5.6	2/16	0-0.21	1/5	0-332	7/44	NONE	NONE
Benzo(b)Fluoranthene	ND	0/12	0-211	3/11	0-32.4	2/16	ND	0/5	0-211	5/44	NONE	NONE
Benzo(a)Pyrene	ND	0/12	0-272	2/11	0-2.5	1/16	ND	0/5	0-272	3/44	0.1	CREG
Indeno(1,2,3-cd)Pyrene	ND	0/12	0-136	1/11	ND	0/16	ND	0/5	0-136	1/44	NONE	NONE
Benzo(g,h,i)Perylene	ND	0/12	0-113	2/11	ND	0/16	ND	0/5	0-113	2/44	NONE	NONE

Compound	Site G Levels		Site H Levels		Site I Levels		Site L Levels		Area 1 Levels		Comparison Values	
	Range	f	Range	f	Range	f	Range	f	Range	f	Soil (ppm)	Source
Dibenz(a,h)Anthracene	ND	0/12	0-31.7	1/11	ND	0/16	ND	0/5	0-31.7	1/44	NONE	NONE
PESTICIDES/PCBs												
4,4'-DDE	0-135 J	4/12	0-0.78	2/11	ND	0/16	ND	0/5	0-135	6/44	2	C REG
4,4'-DDD	ND	0/12	0-0.43	1/11	0-29.7	2/16	ND	0/5	0-29.7	3/44	3	C REG
4,4'-DDT	ND	0/12	0-0.92	2/11	0-4.3	1/16	ND	0/5	0-4.3	3/44	2	C REG
Toxaphene	ND	0/12	ND	0/11	0-493	1/16	ND	0/5	0-493	1/44	0.6	C REG
AROCLO-1248	0-174	1/12	ND	0/11	ND	0/16	ND	0/5	0-174	1/44	0.01/0.3	C EMEG
AROCLO-1260	0-662	7/12	0-18000	8/11	0-343	5/16	ND	0/5	0-18000	20/44	0.01/0.3	C EMEG
INORGANICS												
Antimony	ND	0/12	ND	0/11	ND	0/16	0-32	1/5	0-32	1/44	0.8/20	RMEG
Arsenic	0-123 R	11/12	0-389 R	9/11	0-14	10/16	0-172	4/5	0-389 R	34/44	0.4	C REG
Barium	117-45949	12/12	38-3242	11/11	0-3603	10/16	114-197.5	5/5	0-45949	38/44	100/4000	RMEG
Beryllium	ND	0/12	ND	0/11	0-1530	1/16	ND	0/5	0-1530	1/44	0.2	C REG
Cadmium	0-14	3/12	0-294	4/11	0-13	7/16	0-6	1/5	0-294	15/44	0.4/10	C EMEG
Chromium, trivalent	5-985	12/12	0-100	8/11	0-731	14/16	0-16	4/5	0-985	37/44	2000/50000 10/30	RMEG RMEG
Cobalt	0-56	4/12	0-105	5/11	0-140	7/16	0-9	3/5	0-140	19/44	NONE	NONE
Copper	0-2215	11/12	0-2444	8/11	0-575	8/16	12-141	5/5	0-2444	32/44	NONE	NONE
Lead	8-3123	12/12	4-4500 R	11/11	0-23333	15/16	5-106	5/5	0-23333	43/44	NONE	NONE
Manganese	43-461	12/12	7-36543	11/11	36 R-5436	16/16	10-255	5/5	0-36543	44/44	10/300	RMEG
Mercury	0-34.3	2/12	0-3.9	3/11	0-240 R	6/16	0-0.1	1/5	0-343	12/44	NONE	NONE
Nickel	0-399	10/12	0-15097	10/11	0-2405	12/16	21-2392	5/5	0-15097	37/44	NONE	NONE

Compound	Site G Levels		Site H Levels		Site I Levels		Site L Levels		Area J Levels		Comparison Values	
	Range	†	Range	†	Range	†	Range	†	Range	†	Soil (ppm)	Source
Selenium	ND	1/12	0-2	1/11	0-1320	1/16	ND	0/5	0-1320	2/44	6/200	C EMEG
Silver	0-12	1/12	0-44	3/11	ND	0/16	ND	0/5	0-44	4/44	10/300	RMEG
Thallium	ND	0/12	0-1	1/11	ND	0/16	ND	0/5	0-1	1/44	NONE	NONE
Vanadium	0-1315	11/12	0-95	6/11	0-553	7/16	0-25	2/5	0-1315	26/44	NONE	NONE
Zinc	27-2954	12/12	8-39516	11/11	13-6329	16/16	10-166	5/5	0-39516	44/44	600/20000	RMEG
Cyanide	ND	0/12	0-2	2/11	0-3163	3/16	ND	0/5	0-3163	5/44	40/1000	RMEG

† - Soil values are for pica child/child.

B = Compound found in blank.

J = Estimated value

E = Estimated value with the concentration of the compound exceeding the instrument's calibration range.

Soil concentrations in ppm.

Table 4. On-site Contaminants in Area 1 Groundwater

Compound	Concentration Range in ppb					Comparison Value	
	Site G	Site H	Site I	Site L	Area 1	Water (ppb)	Source
VOLATILES							
Vinyl Chloride	ND	ND	0-790	ND	0-790	0.2	C EMEG
Carbon Disulfide	ND	ND	0-790	ND	0-790	1000	RMEG
1,1-Dichloroethene	ND	ND	0-10	ND	0-10	90	C EMEG
1,1-Dichloroethene	ND	ND	0-12	ND	0-12	0.4	C REG
trans-1,2-Dichloroethene	0-200 J	ND	0-640000	ND	0-640	200	RMEG
Chloroform	ND	0-3000	0-110 J	730	0-3000	100	C EMEG
1,2-Dichloroethane	0-480	ND	ND	ND	0-480	0.4	C REG
2-Butanone (MEK)	0-560	ND	ND	ND	0-560	NL	NL
1,1,1-Trichloroethane	0-51 J	ND	ND	ND	0-51	200	LTHA
Trichloroethene	0-800	ND	0-270	ND	0-800	3	C REG
Benzene	0-4100	0-4300	0-1400	150	0-4300	1	C REG
4-Methyl-2-pentanone	0-2200	0-3600	0-230 J	270 B	0-3600	NL	NL
2-Hexanone	ND	ND	0-4 J	ND	0-4 J	NL	NL
Toluene	0-7300	0-7300	0-740	970 B	0-7300	2000	RMEG
Chlorobenzene	1-3100	0-11000	0-3100	ND	0-11000	4000	I EMEG
Styrene	0-50 J	ND	ND	ND	0-50 J	20000	C EMEG
SEMI-VOLATILES							
Phenol	0-30000	0-950	0-1800	150	0-30000	6000	RMEG
2-Chlorophenol	0-1900	0-47	0-370	150	0-1900	50	RMEG

Compound	Concentration Range in ppb					Comparison Value	
	Site G	Site H	Site I	Site L	Area 1	Water (ppb)	Source
1,3-Dichlorobenzene	0-4 J	0-120	0-110	ND	0-120	600	LTHA
1,4-Dichlorobenzene	0-570	0-2600	0-910	ND	0-2600	75	LTHA
1,2-Dichlorobenzene	0-200 J	0-560	0-220	ND	0-560	600	LTHA
2-Methylphenol	0-810	0-71	0-89	6 J	0-810	500	RMEG
4-Methylphenol	0-9000	0-620	0-350	75	0-9000	NONE	NONE
Isophorone	ND	0-110 J	ND	ND	0-110 J	2000	C EMEG
2-Nitrophenol	ND	ND	ND	41	0-41	NONE	NONE
2,4-Dimethylphenol	0-4300	ND	ND	ND	0-4300	NONE	NONE
bis-(2-Chloroethoxy)methane	0-7300	ND	0-2900	ND	0-7300	NONE	NONE
2,4-Dichlorophenol	0-480 J	0-1900	0-1000	ND	0-1900	30	RMEG
1,2,4-Trichlorobenzene	0-199	0-720	0-2700	ND	0-2700	100	RMEG
Naphthalene	0-21000 E	0-250	0-230	ND	0-21000 E	20	LTHA
4-Chloroaniline	0-15000 E	0-6400	0-9600 E	60	0-15000 E	40	RMEG
2,4,6-Trichlorophenol	0-350	0-1200	0-290	ND	0-1200	3	CREG
2,4,5-Trichlorophenol	ND	0-580	ND	ND	0-580	1000	RMEG
Dimethyl Phthalate	0-980	0-8 J	ND	ND	0-350	NONE	NONE
Dibenzofuran	ND	0-6 J	ND	ND	0-6 J	NL	NL
4-Chlorophenyl-Phenylether	ND	0-20 J	ND	ND	0-20 J	NL	NL
Fluorene	ND	ND	0-25 J	ND	0-25 J	400	RMEG
N-Nitrosodiphenylamine	ND	0-800	ND	ND	0-800	500	C EMEG

Compound	Concentration Range in ppb					Comparison Value	
	Site G	Site H	Site I	Site L	Area 1	Water (ppb)	Source
Pentachlorophenol	0-6300	0-650	0-2400	ND	0-6300	0.3	CREG
Phenanthrene	ND	0-15 J	ND	ND	0-15 J	NL	NL
Di-n-butyl phthalate	0-12 J	ND	0-7 BJ	6 BJ	0-7 BJ	NONE	NONE
bis(2-ethylhexyl) phthalate	0-4 BJ	0-24 J	0-20 BJ	ND	0-24 J	NL	NL
Chrysene	0-6 J	ND	ND	ND	0-6 J	0.2	PMCL
Di-n-octyl phthalate	ND	ND	0-1 J	ND	0-1 J	NL	NL
PESTICIDES/PCBs							
Alpha BHC	0-7 C	ND	ND	ND	0-7 C	NL	NL
AROCLOR-1260	0-890	0-52	ND	ND	0-890	0.05	C EMEG
INORGANICS							
Antimony	0-63	ND	ND	ND	0-63	4	RMEG
Arsenic	0-179	0-8490	0-15	14000	0-14000	0.02	CREG
Barium	0-610	ND	0-956	ND	0-956	700	RMEG
Cadmium	0-22	0-70 R	ND	ND	0-70 R	2	C EMEG
Chromium, trivalent hexavalent	0-410	0-24	ND	ND	0-24	10000/30 000 50/200	RMEG RMEG
Cobalt	0-588	0-758	ND	84	0-758	NONE	NONE
Copper	ND	0-2410	ND	ND	0-2410	1300	MCL
Lead	ND	0-28	ND	ND	0-28	50	MCL
Manganese	0-7240	0-8020	0-1580	7660	0-8020	50	I EMEG
Nickel	0-349	0-17200	0-95	ND	0-17200	100	LTHA

Compound	Concentration Range in ppb					Comparison Value	
	Site G	Site H	Site I	Site L	Area 1	Water (ppb)	Source
Vanadium	0-94	ND	ND	159	0-159	20	NONE
Zinc	14-1910	2500-6840	0-26	2210	0-6840	3000	RMEG
Cyanide	0-26	0-480	ND	ND	0-480	200	RMEG

* - RMEG and EMEG values for water are for children.

Table 5. Airborne Contaminant Concentrations for Sites G and CS B

Compound/ CV	Concentration Range in ug/m ³										Comparison Value	
	Site G	f	Site I	f	Site CS B	f	Off-site	f	Area 1	f	Air ug/m ³	Source
VOLATILES												
Benzene*	66 JB-118 JB	4/4	51 JB-63 BJ	2/2	67 JB-60 JB	2/2	70 JB-75 JB	2/2	51 JB-118 JB	10/10	0.1	CREG
SEMIVOLATILES												
Benzyl alcohol	0-0.05 J	1/6	ND	0/2	ND	0/2	ND	0/2	0-0.05 J	1/12	NL	NL
Isophorone	0-0.01 J	1/6	ND	0/2	ND	0/2	0-0.02 J	1/2	0-0.02 J	2/12	NL	NL
Naphthalene	0-0.2	2/6	ND	0/2	ND	0/2	ND	0/2	0-0.2	2/12	NL	NL
2-Methylnaphthalene	0-0.02 J	1/6	0-0.03 J	1/2	ND	0/2	0-0.02 J	1/2	0-0.03 J	3/12	NL	NL
2-Nitroaniline	0-0.44	1/6	ND	0/2	ND	0/2	ND	0/2	0-0.44	1/12	NL	NL
Fluorene	0-0.02 J	1/6	0-0.02 J	1/2	ND	0/2	ND	0/2	0-0.02 J	2/12	NL	NL
N-Nitrosodiphenylamine	0-0.05 J	2/6	ND	0/2	ND	0/2	ND	0/2	0-0.05 J	2/12	NL	NL
Fluoranthene	0-0.01 J	1/6	ND	0/2	ND	0/2	ND	0/2	0-0.01 J	1/12	NL	NL
Pyrene	0-0.02 J	1/6	ND	0/2	ND	0/2	ND	0/2	0-0.02 J	1/12	NL	NL
PESTICIDES/PCBs												
AROCLOR-1248	0.11-0.30	6/6	ND	0/2	0-0.04	1/2	ND	0/2	0-0.30	7/12	NONE	NONE
AROCLOR-1254	0-0.18	2/6	ND	0/2	ND	0/2	ND	0/2	0-0.18	2/12	NONE	NONE
AROCLOR-1260	0-0.17	2/6	ND	0/2	ND	0/2	ND	0/2	0-0.17	2/12	NONE	NONE
INORGANICS												
Chromium, trivalent hexavalent	0-0.06	1/6	ND	0/2	ND	0/2	ND	0/2	0-0.006	1/12	NONE 0.00006	NONE CREG
Copper	0.62-0.94	6/6	0.66-0.78	2/2	0.67-0.87	2/2	0.36-0.38	2/2	0.35-0.94	12/12	NL	NL
Lead	0.04-0.67	6/6	0.09-0.64	2/2	0.9-0.77	2/2	0.04-0.06	2/2	0.04-0.77	12/12	NONE	NONE
Zinc	0.11-0.92	6/6	0.031-1.4	2/2	0.32-0.56	2/2	0.06-0.13	2/2	0.06-1.4	12/12	NL	NL

* - Benzene was detected in the field blanks at concentrations of 17 and 15 ug/m³
Air values in ug/m³ unless otherwise noted.

J - Estimated Value

B - Compound found in blank.

ND - Not Detected in the sample.

Table 6. Sediment Analyses for Area 1.

Contaminant	Area 1 Sediment Contaminant Concentration Ranges in mg/kg							Comparison Value	
	Site M	CS-A	CS-B	CS-C	CS-D	CS-E	CS-F	Area 1	ppm
VOLATILES									
2-Butanone	0.51-218	0-1.28	11-14	118-228	188-368	ND	ND	0-368	NL
Benzene	ND	ND	0-0.87	ND	ND	ND	ND	0-0.87	CREG
4-Methyl-2-pentanone	ND	ND	0-0.22 J	ND	ND	ND	ND	0-0.22 J	NL
2-Hexanone	ND	0-9.3 BJ	0-62 B	0-1.2 J	ND	ND	ND	0-528	NL
Toluene	ND	ND	0-0.81	ND	ND	0-0.029	ND	0-0.81	400/10000
Chlorobenzene	ND	0-4.8 J	0-5.2	ND	0-0.006 J	0-0.12	ND	0-5.2	800/20000
SEMIVOLATILES									
Phenol	ND	ND	ND	0-0.58 J	ND	ND	ND	0-0.58 J	1000/30000
1,3-Dichloro-benzene	ND	0-5.5 J	ND	0-0.11 J	ND	ND	ND	0-5.5 J	NONE
1,4-Dichloro-benzene	ND	0-2.9	0-22	0-0.13 J	0-0.87 J	0-1.5	ND	0-22	NONE
1,2-Dichloro-benzene	ND	0-0.48	0-17 J	ND	0-0.32 J	ND	ND	0-17	200/5000
4-Methyl-phenol	ND	ND	ND	ND	ND	0-1.1	0-1.1	0-1.1	NONE
1,2,4-Trichloro-benzene	ND	0-1.5 J	0-5.4 J	0-0.26	ND	ND	ND	0-5.4 J	20/500
Naphthalene	ND	0-0.13 J	0-9.5 J	0-0.33 J	ND	ND	ND	0-9.5 J	NONE
4-Chloroaniline	ND	0-1.0	ND	ND	ND	ND	ND	0-1.0	8/2000
2-Methyl-naphthalene	ND	0-0.45 J	0-8.4 J	ND	ND	ND	ND	0-8.4 J	NONE
Ac-naphthalene	ND	0-0.17 J	ND	0-0.13 J	ND	ND	ND	0-0.17 J	100/3000
4-Nitrophenol	ND	ND	0-2.6	ND	ND	ND	ND	0-2.6	NONE
Fluorene	ND	ND	0-3.9 J	0-0.37	ND	ND	ND	0-3.9 J	80/2000
N-Nitroso-diphenylamine	ND	0-0.22	ND	ND	ND	ND	ND	0-0.22	NONE

Contaminant	Area 1 Sediment Contaminant Concentration Ranges in mg/kg								Comparison Value	
	Site M	CS-A	CS-B	CS-C	CS-D	CS-E	CS-F	Area 1	ppm	Source
Hexachloro-benzene	ND	0-1.1 J	0-1.9	ND	ND	ND	ND	0-1.9	2/40	C EMEG
Penta-chlorophenol	ND	0-0.8	0-0.94	ND	ND	ND	ND	0-0.94	6	C REG
Phenanthrene	ND	0-0.19	0-15	0-0.81	0-0.22 J	0-0.32 J	ND	0-15	NL	NL
Di-n-butyl phthalate	0-0.56 J	0-0.9 J	0-0.3 J	0-0.12 J	0.079 J-0.13 J	ND	ND	0-0.9 J	NONE	NONE
Fluoranthene	ND	0-0.6 J	0-11 J	0-4.6	0-0.81 J	ND	0-0.31 J	0-11 J	60/2000	RMEG
Pyrene	ND	0-1.4 J	0-13 J	0-4.5	0-0.48 J	0-0.475	0-0.34 J	0-13	60/2000	RMEG
Benz(a)-Anthracene	ND	ND	0-0.43 J	0.23-3.3	ND	ND	ND	0-3.3	NL	NL
bis(2-ethylhexyl) phthalate	0-9.9 J	0-2.9	0-0.54 J	0-7.4	0-0.72 J	ND	ND	0-7.4	NONE	NONE
Chrysene	ND	0-1.7 J	0-1.2 J	0.3 J-4.4	0-0.83	0-2.8	ND	0-4.4	NONE	NONE
Di-n-octyl phthalate	0-0.27 J	0.3 J-1.1	0-2.6 J	0-0.19	0-0.17 J	ND	ND	0-2.0	NONE	NONE
Benzo(b) Fluoranthene	ND	0-1.0 J	0-3.4 J	0-7.5	0-0.5 J	0-2.4	ND	0-7.5	NONE	NONE
Benzo(k) Fluoranthene	ND	ND	0-1.5J	0-0.92	0-0.48 J	ND	ND	0-1.5	NONE	NONE
Benzo(a)Pyrene	ND	0-0.54 J	0.95-1.8 J	0.35 J-4.5	0-240 J	ND	ND	0-240 J	0.1	C REG
Indeno-(1,2,3-cd)Pyrene	ND	0-0.57 J	0-1.4 J	0.53 J-4.3	0-0.81 J	ND	ND	0-4.3	NONE	NONE
Benzo(g,h,i) Perylene	ND	ND	0-0.39 J	0-1.5 J	ND	ND	ND	0-1.5 J	NONE	NONE
Dibenz(a,h) Anthracene	ND	0-0.96	0-1.8	0.47 J-4.0	0-0.36 J	ND	ND	0-4.0	NONE	NONE
PESTICIDES/PCBs										
4,4'-DDE	ND	ND	ND	ND	ND	ND	0-0.097	0-0.097	2	C REG
Endrin	ND	ND	ND	ND	0-0.58	0-0.98	0-0.066	0-0.98	0.6/20	C EMEG
Endosulfan II	ND	ND	ND	ND	0-0.21	ND	0-0.20	0-0.21	0.4/10	I EMEG
beta BHC	ND	ND	ND	ND	0-0.001 J	ND	ND	0-0.001	0.39	C REG

Contaminant	Area 1 Sediment Contaminant Concentration Ranges in mg/kg								Comparison Value	
	Site M	CS-A	CS-B	CS-C	CS-D	CS-E	CS-F	Area 1	ppm	Source
Polychlorinated Biphenyls ¹	0.66-35.7J	6.5-167C	6.6JC-687C	0-27.5J	0-13.9	0-60	0-5.4	0-687	0.01/0.3	C EMEG
INORGANICS										
Arsenic	3.6R-16R	12R-76R	13R-21	5.1R-33R	3.2-7.8	10.1-30.3	2.6B-19.5	2.6B-76R	0.4	C REG
Barium	131-196	267-732	410-17300	376-1700	198-622	174-3690	152-313	131-17300	100/4000	RMEG
Cadmium	1.5-11	17-31	8.2-36	17-42	5.6-42	1.8-23.1	0-23.5	0-42	0.4/10	C EMEG
Chromium, trivalent hexavalent	15-53	34-121	62-153	41-68	13-48	29.4-105	22.3-37.7	13-153	2000/50000 10/30	RMEG RMEG
Cobalt	5-7.7	0-27	6-11	6.6-10	0-12	0-127 B	0-18.8	0-127 B	NONE	NONE
Copper	167-1780	2620-11400	2610-15300	580-6640	247-1630	108-6540	13.7-520	13.7-15300	NONE	NONE
Lead	26-71	225-2030	330-1460	467-975	44-480	140-1270	6.3-83	26-2030	NONE	NONE
Manganese	97-139	66-296	70-218	98-177	178-273	4880-7880	2270-5330	66-7880	10/300	RMEG
Mercury	0-0.56	1.18-5.62	0.9-1.68	0.71-2.8	0.18-1.0	0.32-1.53	0-3.4	0-5.62	NONE	NONE
Nickel	258-356	255R-765R	56R-1520R	116.R-1280 R	174 R-665 R	56-2130	17.4-772	56-1520 R	NONE	NONE
Selenium	ND	0-3.3	0-4.1	0-2.25	ND	ND	ND	0-4.1	6/200	C EMEG
Silver	ND	6-33	0-15	ND	ND	ND	ND	0-33	10/300	RMEG
Thallium	ND	ND	0-4	ND	ND	ND	ND	0-4	NONE	NONE
Vanadium	0-19	20-25	23-48	22-36	0-37	29.3-53.3	30.8-54.3	0-54.3	NONE	NONE
Zinc	866-1010	1230-2740	3310-11900	1370-15600	917-6590	362-9970	53.1-4520	53-15600	600/20000	RMEG
Cyanide	ND	ND	0-3.8	ND	ND	NS	NS	0-3.8	40/1000	RMEG

Comparison values for soil were used for sediments.

Soil values are for pica child/child.

1 - Polychlorinated Biphenyls include Aroclors - 1242, 1248, 1254, and 1260, the minimum and maximum concentrations were determined by adding the lowest and highest concentration of each aroclor together to get the PCB concentration range.

B = Compound detected in blank samples.

C = Result confirmed by GC/MS.

J = Estimated value. Concentration is less than the specified detection limit, but greater than zero.

ND: Not detected.

Table 7. Surface Water Contaminants in Area 1

Compound	Concentration Range in ppb						Comparison Value	
	Site M	CS-A	CS-B	CS-C	CS-D	Area 1	ppb	Source*
VOLATILES								
Chloroform	0-27	7-8	ND	ND	ND	0-27	100	C EMEG
1,1,1-Trichloroethane	ND	33-41	ND	ND	ND	0-41	200	LTHA
Carbon Tetrachloride	ND	0-31	ND	ND	ND	0-31	0.3	CREG
Trichloroethene	ND	6-16	ND	ND	ND	0-16	3	CREG
Benzene	ND	ND	ND	ND	0-1 J	0-1 J	1	CREG
4-Methyl-2-pentanone	ND	0-6 J	ND	ND	ND	0-6 J	NL	NL
Chlorobenzene	ND	0-2 J	ND	ND	ND	0-2 J	4000	1 EMEG
SEMIVOLATILES								
4-Chloroaniline	ND	0-3 J	ND	ND	ND	0-3 J	40	RMEG
2-Nitroaniline	ND	ND	0-9 J	ND	ND	0-9 J	NL	NL
Diethyl phthalate	ND	ND	ND	0-1 J	ND	0-1 J	NONE	NONE
Phenanthrene	ND	0-4 J	ND	ND	ND	0-4 J	NL	NL
Butyl Benzyl phthalate	ND	0-12 J	ND	ND	ND	0-12 J	NONE	NONE
bis(2-ethylhexyl) phthalate	ND	5 J-7 J	ND	ND	ND	0-7 J	NL	NL
Di-n-octyl phthalate	2 J-4 J	1 J-36 J	ND	ND	0-1 J	0-36 J	NL	NL
PESTICIDES/PCBs								
AROCLOR-1260	ND	ND	3.6-44	ND	ND	0-44	0.05	C EMEG
INORGANICS								
Antimony	ND	0-115	ND	ND	ND	0-115	4	RMEG
Arsenic	ND	ND	0-31	ND	ND	0-31	0.02	CREG
Barium	0-200	ND	0-7130	ND	0-274	0-7130	700	RMEG

Compound	Concentration Range in ppb						Comparison Value	
	Site M	CS-A	CS-B	CS-C	CS-D	Area 1	ppb	Source
Cadmium	ND	23-75	0-25	ND	0-8.1	0-75	2	C EMEG
Chromium, trivalent	0-14	65-81	0-99	ND	0-12	0-99	10000/30000 50/200	RMEG RMEG
Copper	46-51	2410-7030	239-17900	84-226	57-619	46-17900	1300	MCL
Lead	0-6.4	76-3060	17-1300	30-710	36-89	0-3060	50	MCL
Manganese	95-97	66-222	141-234	28-196	68-252	28-252	50	1 EMEG
Mercury	ND	0.2-0.59	0-8.6	0.2-1.9	0-0.26	0-8.6	20	1 EMEG
Nickel	0-46	667-2600	0-1500	0-83	0-189	0-2600	100	LTHA
Zinc	73-186	480-1450	302-10300	247-537	185-1090	73-10300	3000	RMEG

* - RMEG and EMEG values for water are for children.

B = Compound detected in blank samples.

C = Result confirmed by GC/MS.

J = Estimated value. Concentration is less than the specified detection limit, but greater than zero.

ND- Not detected.

Table 8. Off-site Contaminants in Area 1 Groundwater

Compound	Concentration Range in ppb						Comparison Value	
	Site G	Site H	Site I	Site L	Private Wells	Area 1	Water (ppb)	Source
VOLATILES								
Vinyl Chloride	ND	ND	0-790	ND	ND	0-790	0.2	C EMEG
Carbon Disulfide	ND	ND	0-5 J	ND	0-3	0-5 J	1000	RMEG
Chloroform	0-9	ND	ND	ND	0-2 J	0-9	100	C EMEG
Benzene	0-2 J	0-1 J	0-28	1 J	ND	0-28	1	C REG
Toluene	0-3 J	ND	ND	ND	0-1 BJ	0-3 J	2000	RMEG
Chlorobenzene	0-5	0-6	0-33	1 J	ND	0-33	4000	1 EMEG
Styrene	ND	ND	ND	ND	0-2 J	0-2 J	20000	C EMEG
SEMI-VOLATILES								
Naphthalene	0-8 J	ND	ND	ND	ND	0-8 J	20	LTHA
4-Chloroaniline	ND	0-30	0-14	ND	ND	0-30	40	RMEG
Hexachlorobenzene	0-6 J	ND	ND	ND	ND	0-6 J	8	C EMEG
Pentachlorophenol	0-12 J	ND	0-6 J	ND	ND	0-12 J	0.3	C REG
Di-n-butyl phthalate	0-2 BJ	ND	2 BJ-4 BJ	9 BJ	ND	0-9 BJ	NONE	NONE
Benz(a)Anthracene	0-32	ND	ND	ND	ND	0-32	NONE	NONE
bis(2-ethylhexyl) phthalate	0-24	ND	ND	ND	ND	0-24	NL	NL
Chrysene	0-6 J	ND	ND	ND	ND	0-6 J	0.2	PMCL
Di-n-octyl phthalate	ND	ND	ND	ND	0-6 J	0-6 J	NL	NL
Tetrachloroethene	0-14 J	ND	ND	ND	ND	0-14 J	0.18	C REG
PESTICIDES/PCBs								
ARCTOR 1260	0-14 J	ND	ND	ND	ND	0-14 J	0.05	C EMEG

Compound	Concentration Range in ppb						Comparison Value	
	Site G	Site H	Site I	Site L	Private Wells	Area 1	Water (ppb)	Source*
INORGANICS								
Antimony	0-63 R	ND	ND	ND	ND	0-63 R	4	RMBG
Arsenic	ND	ND	ND	ND	0-26	0-26	0.02	CREG
Barium	0-219	0-173	0-22.3	331	0-292	0-331	700	RMBG
Lead	ND	ND	ND	ND	0-18 R	0-18R	50	MCL
Manganese	103-2230	274-1800	0-1650	1280	257-1660	0-2230	50	1 EMEG
Mercury	0-2.1	ND	ND	ND	0-0.2	0-0.2	20	1 EMEG
Nickel	ND	0-111	ND	ND	ND	0-111	100	LTHA
Zinc	24-42	24-53	ND	24	377-4140	0-4140	3000	RMBG
Cyanide	0-350	ND	ND	ND	ND	0-350	200	RMBG

* - RMBG and EMEG values for water are for children.

R = Compound detected in blank samples.

C = Result confirmed by GC/MS.

J = Estimated value. Concentration is less than the specified detection limit, but greater than zero.

ND- Not detected.

R = Spike sample recovery not within control limits.

TABLE 9. COMPLETED EXPOSURE PATHWAYS

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATIONS	TIME
Ambient Air	Surface Wastes Surface Soil Subsurface Soil Site Operations Plant Activities Exposed Sediments	Air	Residential yards and homes. Workers in area industries and businesses. Unprotected workers on-site.	Inhalation	Sauget, Cahokia, and E. St. Louis residents. Employees in area businesses and industries. Site workers.	Past Present Future
Surface Soil	Surface Wastes Site Operations On-site soils	Soil	Yards Creek Banks	Ingestion Inhalation	Sauget, Cahokia, and E. St. Louis residents. Site workers.	Past Present Future
Subsurface Soil	Surface wastes Surface soil Ground water Surface water	Soil	On-site subsurface soils.	Dermal contact Inhalation Ingestion	Nearby residents. Site workers.	Past Present Future
Sediments	Contaminated Soils Airborne Deposition Surface Water Ground Water	Sediments	Dead Creek - Creek Bed Sections CS-A thru CS-F Site M Site L	Ingestion Inhalation Dermal-Contact	Sauget and Cahokia Residents living near Dead Creek On-site workers.	Past Present Future
Surface water	Sediments Soil Ground water Runoff water Airborne deposition	Water	Surface water standing in the creek sectors. Surface water at the sites L and M.	Ingestion Inhalation Dermal-Contact	Residents that come into contact with contaminated surface water. On-site workers. Nearby down wind residents.	Past Present Future
Ground water	Surface Wastes Surface Soils Subsurface Soils Surface Water	Ground water	Ground water wells. Ground water seeping onto the surface.	Ingestion Inhalation Dermal-Contact	Residents who use contaminated wells. Workers excavating areas with contaminated ground water.	Past Present Future
Vegetables	Contaminated Soil Air Deposition Contaminated Ground Water	Fruits and Vegetables	Fruits and vegetables grown near Area I	Ingestion	Residents with Gardens or Fruit Trees.	Past Present Future